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Contents for November, 1930

Part of the Plant of the Fir-Tex Insulating Board Company at St. Helens, Ore. Douglas Fir Waste Will Be Utilized in Making the Board

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CHEMICAL & METALLURGICAL ENGINEERING

VOLUME 37 NUMBER 11

A McGRAW-HILL PUBLICATION—ESTABLISHED 1902

S. D. KIRKPATRICK, *Editor*

November, 1930

Building for Greater Flexibility In Industry

A FEW YEARS AGO when Henry Ford finally decided to change the old Model T to the new Model A, his plants were closed for almost a year. Did other manufacturers sit back and wait to see what their rival intended to do? No. New competition appeared almost over night. Skilled in the technique of annual models, these firms possessed a certain flexibility that Ford did not have. They could change, and change quickly, in order to capitalize fully on current advantages.

THERE is a parallel in the present business hiatus. Many older industries, lacking flexibility in their industrial structure, have been unable to adapt themselves promptly to changed conditions. This is seldom true, however, in the case of chemical industries, whose very progress depends on the processes of change. It will be recalled that much was said during the war about the overnight shifts from dyes to poison gases or explosives, and about the after-war readjustments from smokeless powder to lacquer or rayon. Today we see comparable changes in industry as a chemical company shifts the burden of its production from, say, automobile finishes to cellophane or from fertilizers to some new synthetic plastic. Sometimes the change is only in a single step in the manufacturing operation; e.g., a spray dried soap or phosphate compound finds a preferential market and thus meets with the fancy of a fickle public. Apparently now is the time to translate the results of research into new and more profitable business.

UNFORTUNATELY, not all process industries have this desirable flexibility. Certain of the older inorganic lines, such as the acids and alkalis, have been more severely affected by the business depression than the newer, organic chemical industries. In all, however, there is an opportunity for more intensive research directed toward new materials or new fields of application for present products. The industries that can best withstand a business recession are those which, because of the novelty of their products, have no direct competition, or, because of the diversity of their output, are not dependent upon a single market.

THESE basic facts, even if they may appear elementary and a bit threadworn, are earnestly commended to those in control of chemical engineering industries and operations. Recent experience has amply demonstrated the great present interest in new developments. Hydrogenation — itself a model of flexibility in operations and products — appears as the basis of tomorrow's oil refinery. New processes and newly designed equipment are demanding attention in other industries that are preparing for better times. Lack of flexibility is an unnecessary handicap if an industry is awake to its present opportunities.

EDITORIALS

NOVEMBER, 1930

Ellwood Hendrick—Ave Atque Vale

TO RECORD the passing of Ellwood Hendrick by referring to his contributions to chemistry is to quote from the Book of the Obvious—a volume conspicuously absent from his own library. True, his name will live in the annals of the science, with that of the late E. E. Slosson, as one who by the facile genius of his pen breathed life into the dry bones of chemistry. Between the two men, however, was this difference: Slosson converted chemistry into news; Hendrick wove it with elfin strands of imagery into a fairy story, thrilling alike to scientist and layman.

This the world of chemistry knows, and will remember. But we, of *Chem. & Met.*, privileged to a close association with Doctor Hendrick during his happy years as our consulting editor, choose to remember him as a rich personality, a magic well of character, replenished as rapidly as he drew from it for all who came to drink. Ever fresh, sparkling, whimsical, mellow, full of delightful appreciation for the pleasant things of life, he was, unwittingly perhaps, a "saving remnant" of true culture, and as such his pattern has been woven into the stuff of many lives. Instinctively and intellectually an aristocrat, the warmth of his friendliness knew no boundaries of caste or creed. With men as with science, he was a "humanizer"; his friends, like his books, were ecstatic experiences. He romped with equal facility and delight through "Alice in Wonderland" and Langmuir's postulates—at once the Peter Pan and the Grand Old Man of Chemistry.

There is poignant sorrow in our valedictory to Ellwood Hendrick. Yet if his friends would keep the faith they will not mourn his death. Rather will they rejoice and be glad in the benediction of such friendship.

Unseemly Conduct in Chemical Competition

IT IS generally regarded as bad taste for big brother to smack little brother with a stick or hit him with a brick, even when little brother does undertake to eat some of the family candy. In business it is generally regarded as bad sales policy to "run down" a competitor. And yet lately we have observed this sort of unseemly conduct in chemical competition between big brother ethyl alcohol and aggressive little brother methanol.

There has been an epidemic of criticisms, many of them fabrications far from the truth, spread abroad in the daily newspapers and the popular press in an effort to discredit the use of methanol as an anti-freeze on the ground of public danger.

Frankly, we do not like to see such conduct in the chemical business. It lays the whole industry open to question as to its good faith in dealing with the public. In this particular case it may even prove a boomerang in popular misunderstanding, leading to an abandonment of all kinds of alcohol for anti-freeze purposes. It seems to *Chem. & Met.* that the responsible leaders of the industrial alcohol business should take this situation in hand promptly and see to it that there is no excuse for the appearance of mud slinging.

The Bureau of Mines is investigating the methods for the proper use of methanol and is expected to report during this current month on the necessary precautions to be taken for the safe use of methanol as an anti-freeze. Responsible companies marketing methanol in the automotive field will undoubtedly observe these precautions fully and make sure that no general public hazard is being created. The companies leading in this development have on many occasions demonstrated their competence in the handling of new commodities and their great care in safeguarding the public in the use of new products. The producers of competitive anti-freeze materials should recognize this fact and seek to compete only on a straightforward merit and price basis, and not by insidious attacks on grounds that are not warranted by the technical facts.

Coal Must Face A New Competition

NATURAL GAS development has gone on during the past twelve months at a spectacular rate. Another year or two of equally active expansion of this fuel industry is to be expected. The development is occasioning many radical changes in plan within the gas business itself. These are discussed fully in this issue of *Chem. & Met.* as a part of the report on the recent record-making meeting of American Gas Association.

Another phase of this development also deserves much wider attention than has been accorded to it. This is the competition which gaseous fuel developments are successfully offering to solid fuels, both bituminous and anthracite. If the present projected natural-gas developments continue on the basis which it seems reasonable to expect, the inevitable result will be a supplanting of coal by gas in many industries and in many households. Estimates have been made of the magnitude of this change, which range all the way from 75 to 200 million tons of coal per year, either as at present used or prospectively required, to be replaced by gas. Even the smaller figure suggests rather startling industrial consequences.

That this replacement is no academic or negligible thing is evident. Active steps are being taken by the organized mine workers of Illinois to oppose the building of pipe lines through that state. The miners charge that the pipe lines when completed will destroy their present jobs and wreck the Illinois coal-mining industry. Western railroads, in their formal appeals for rate relief before the Interstate Commerce Commission, cite the slackening of coal traffic, as solid fuel is replaced by gas and oil, as a major factor in their financial problem. They insist that freight rates on a very large number of other commodities must be raised, because, at least in part, the loss in coal traffic is a serious matter in their present and prospective operations.

All of the process industries anticipate advantages from the extensive development of gaseous fuels for process heating and for general public service. They have been

welcoming, and rightly, this development. They must, however, not be blind to the unpleasant consequences, unavoidable though they seem to be, of lessened employment in the coal industry and serious curtailment in freight traffic for our railroads.

New Orleans In December

AGAIN chemical engineering eyes are focused on the South. This time New Orleans, rich in traditions but richer in chemical potentialities, is to be the meeting place for the American Institute of Chemical Engineers. In the ten years since the previous session there, natural gas, petroleum, cellulose, sugar, salt, and sulphur have all had a part in a striking industrial development. In the ten years ahead it is possible to foresee even greater industries arising to use these basic raw materials of the Gulf Coast. Chemical engineers who see these opportunities first hand are the ones who will translate them into profitable achievements. Therefore, both New Orleans and the institute are likely to gain materially by just such a comradery as the winter meeting is likely to develop.

Trade Revival or Good Showmanship?

OBSERVERS at recent expositions in several fields, notably the food-manufacturing industries, are unanimous in believing that there is unusual interest this fall in all kinds of new equipment. In the midst of a period of depressed business activity, this might seem to be a noteworthy tribute to the showmanship of the exhibitors rather than the early stirrings of trade revival. Showmanship there is, undoubtedly, for slow business is certain to catalyze sales effort. But there is more to it than this if past performance be any indicator.

Identical phenomena have ushered in the return of normal conditions in previous depressions. At the peak of pessimism, the gloomier spirits are always too busy forecasting harder times to realize or care that Mr. Average Engineer has already turned his thoughts intensively toward greater economies of production; that new designs and better methods are inevitably in process of development; and that Mr. Average Engineer is going to avail himself of every improvement, regardless of the somber prophets.

Designs must be of the best in times such as these. Equipment makers realize this fact, much to their advantage. Never are their new offerings so prolific as immediately preceding a reconstruction period. That explains why design will be paramount at the Exposition of Power and Mechanical Engineering next month, as well as at the Chemical Exposition next May. It explains also why we are able confidently to predict that there will be an even greater number of chemical engineers than usual who will avail themselves of both opportunities.

Bigger and Better Goat Pastures

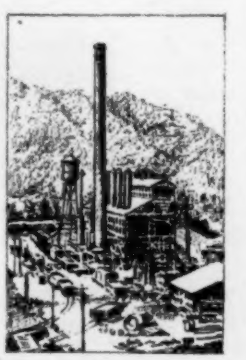
WHILE the universities and colleges of the land are building great libraries and dormitories and stadia, it has been suggested that they should also provide well-appointed goat pastures wherein such of the faculty members as clearly exhibit goat feathers might nibble the succulent green, safe from contacts with a selfish and designing world.

A professor who deliberately sells his name and position in cheap advertising campaigns would by no means gain admission to one of these goat pastures. Indeed, these pastures are reserved for a class of professors who would be the least likely to lend their names wittingly to cheap advertising schemes. They would be both shocked and pained to learn that they had been parties to such. Nevertheless, they constitute almost ideal raw material out of which to build advertising. And here's how they earn their tickets to the goat pastures:

Out in the world somewhere far removed from the campus are two oil companies. One of them makes lubricating oils out of Pennsylvania paraffin-base crudes which (so says this company) are the only oils suitable for the purpose. The other company has no paraffin-base crudes but makes lubricants equally good or even better (so says the second company) out of any old base crudes. Then begins the old story of:

> Two little kittens one stormy night
> Began to quarrel and then to fight.
> One had a mouse and the other had none
> And that's the way the fight begun.

Finally, the company having no mouse but plenty of juicy rat sets out to *prove* its contention. Does it hire oil chemists, chemical engineers, automotive engineers, to put the matter to test? Not at all. It hires a professional publicity man. Does *he* employ the technical men? Not at all. He goes to the Bureau of Business Research of a well known university. Then comes a questionnaire from the Bureau, an innocent looking little questionnaire (prepared with the help of Mr. Publicity Man, of course) going to a list of professors of organic chemistry. The fact that most of these professors know little or nothing of petroleum does not deter them from answering the questionnaire. Here is a great university earnestly attempting to settle for all time a question of large importance to millions of motoring Americans. Of course they answer. A majority of them answer in just the way Mr. P. M. intended they should answer. Next comes a newspaper release from the Bureau, summing up its remarkable findings, supported by "the almost unanimous opinion of 104 professors of organic chemistry in American universities." Of course, the 104 *may* give the correct answer. The theory of probability indicates that they are at least as likely to be right as to be wrong. What the Bureau of Business "Research" does prove beyond question is that the goat pastures must accommodate at least 104 individuals.



One of the Enormous Storage "Vats"; It Contained Originally 650,000 Tons of Sulphur

Producing Sulphur at Newgulf

By GEORGE H. REID

Chemical Engineer

Houston, Tex.

BETWEEN GULF and Houston, the town of Newgulf has been constructed by the Texas Gulf Sulphur Company, and here the company has recently begun mining the Boling Dome and Long Point Dome. Both of these areas are leased from the Gulf Oil Corporation. At the rate of production of 1,403,640 long tons of sulphur in 1929, reserves are estimated to be sufficient for 40 years.

Texas Gulf Sulphur Company is the world's largest producer of sulphur. Freeport Texas Company, owner of Bryanmound (which has a present estimated life of three years) and lessor of Hoskins Mound from The Texas Corporation (12 years' estimated life), and with other reserves, is the second largest producing company, having mined last year a total of 916,260 long tons. These two companies, which operate their properties similarly, produced over 95 per cent of the total United States production of 2,363,389 long tons last year, and nearly 80 per cent of the total world production. Stocks as of Jan. 1, 1930, were 1,900,000 long tons. Exports for 1929 were 855,500 long tons.

Superheated water, injected through 6-in. casings at approximately 100 lb. pressure into wells ranging in depth from 500 to 1,500 ft., melts the rhombic sulphur deposited above a stratum of gypsum. The water settles to the gypsum but its pressure forces the liquefied sulphur upward through a 3-in. line of tubing strung inside of the larger casing. Compressed air at 500 lb. pressure is injected through a 1-in. pipe placed inside the 3-in. line, jetting hot liquid sulphur (melting point, 239 deg. F.) out of the well to relay stations or sumps, and ultimately to storage vats. This is the application of the famous Frasch process (on which the patents have now expired) at the sulphur mining operations of the Texas Gulf Sulphur Company at Boling Dome, near Wharton, Texas. Similar operations prevail at Freeport Texas Company's Bryanmound and Hoskins Mound, near Freeport, Texas.

To provide sufficient heat for large-scale mining, enormous quantities of water, heated under pressure to a temperature considerably above the melting point of sulphur, must be pumped into the sulphur-bearing formation. The quantity varies from 10 to 50 tons of water per ton of sulphur mined, depending upon the nature of the sulphur deposit at the point of penetration. The primary requisites for successful operations of this type are, therefore, a suitable water supply and an efficient power plant for the heating of this water.

Chemical Feed Equipment for Four of the Cochrane Hot-Process Softeners, Including Mixing Tanks, Flow Proportioners and Pumps

Taken over a period it is estimated that Boling Dome operations may require an average of 5,000,000 gal. of water per day, which finds its way into the project through such uses as steam generation for operating drilling rigs, for heating miles of liquid-sulphur transfer pipe lines which must be maintained hot, and for the operation of steam turbines used to drive generators, blowers, fans, and pumps. Its principal use is that of a heating medium for melting crystalline sulphur at the bottom of the wells or mines; but it also cools compressors and is distributed through the fields, where it is used in drilling, maintaining drilling mud consistencies, and filling other needs.

Water is taken both from wells and from the San Bernard River. The supply of river water varies with the season, and a reservoir covering 262 acres, with a capacity of a billion gallons, has been constructed to tide over the low-water periods. Water from the river contains permanent hardness, and often suspended matter; while that from the wells contains sodium carbonate alkalinity. Hence, in the subsequent hot-process softening, the treatment of the river water with the well water suffices to precipitate the permanent hardness with little or no additional sodium carbonate. It is necessary only to add lime and sufficient ferrous sulphate to coagulate the suspended matter.

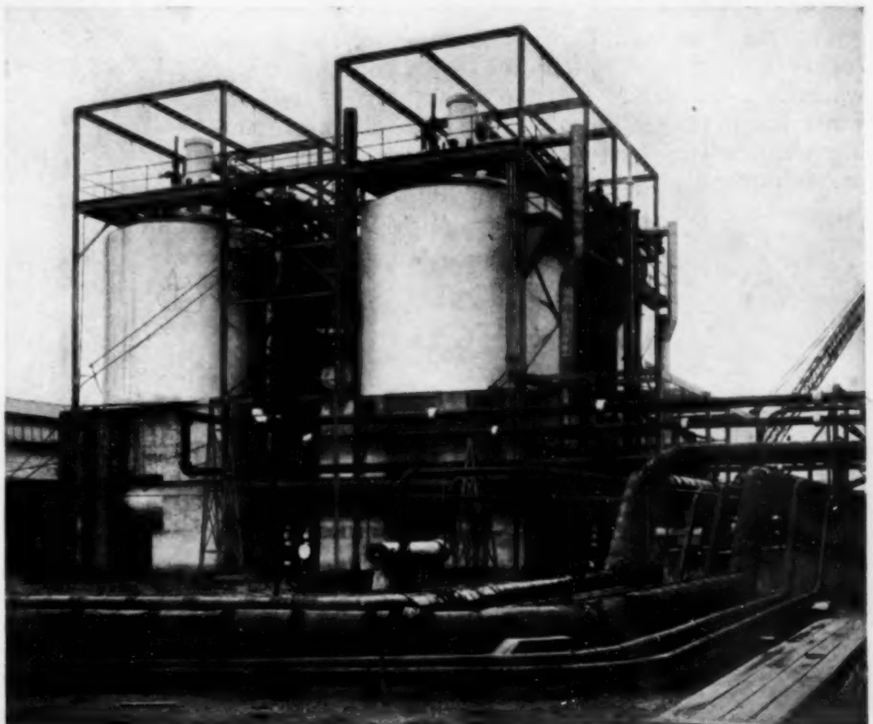
At the power plant two water circuits are maintained. The first raw-water system passes through the treating or softening plant and into the boilers. The second circuit passes through a separate treating system, into the high-pressure mine-water heaters, and to the mines through a heavily insulated 16-in. distributing main. The usual third circuit of cooling water for compressor and engine jackets is, of course, maintained.

Three of the Cochrane Jet Heaters for Mine Water, Each of 75,000 Gal. per Hour Capacity at 100 Lb. Gage Pressure

The power house is of modern construction and design, consisting of ten 1,500-hp. Stirling type water-tube boilers set in two batteries of five each. Separate brick stacks, 38 ft. bottom inside diameter, 18 ft. top inside diameter, and 330 ft. in height are provided, one for each battery. Furnace walls are air-cooled.

Boiler feed water is supplied through four turbine-driven centrifugal pumps, operating under automatic control. It is measured to the power plant by recording orifice meters, at a feed temperature of 220 deg. F. Gas burners are used for firing, with auxiliary or stand-by equipment for oil burning provided at each burner for almost instant use in event of gas failure.

Operating at low pressure, the boilers provide steam at about 100 lb., discharging into a common header system from which live steam is taken for superheating the mine water used in the wells for melting sulphur, and for operation of the turbine-driven centrifugal pumps and electric generators. Large quantities of live steam are also taken to the field for operating and heating purposes.



Sedimentation Tanks for First Four Cochrane Hot-Process Softeners; Each Has Capacity of 70,000 Gal. per Hour

Although steam is employed for the operation of compressor and pumping equipment in the main plant building, electricity is required for power purposes at outlying stations and for lighting purposes in the plant, field, and in the company's town of Newgulf. The electric generating plant, housed in the same building with steam plant, compressor units, pumping equipment, and mine water heaters, consists of three turbo-generators, two of which are of 750 kw., and the third of 1,500 kw. capacity, all designed to operate at 3,600 r.p.m. and 100 lb. steam pressure. The turbines which are employed here and the 20 turbines used for operation of centrifugal pumps, as well as the turbines operating fans and blowers in the same building, are all of the non-condensing type.

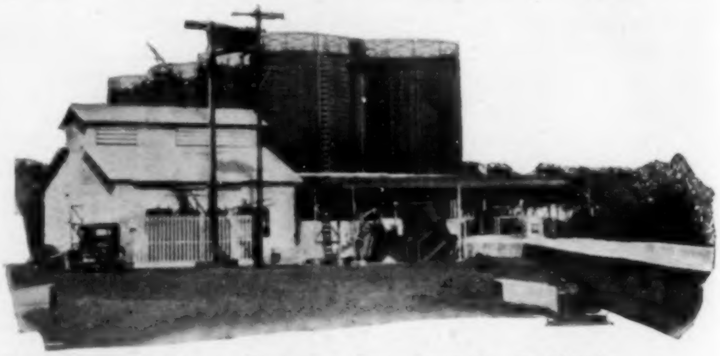
Exhaust steam from these turbines is conducted to a large water-treating plant built by the Cochrane Corporation, of Philadelphia, where it is employed in the hot-softening process to heat the incoming raw water to slightly over 212 deg. F. This steam is condensed and reclaimed for further evaporation or injection into the mines (wells). Six 70,000-gal. sedimentation tanks are installed in the water-treating system. Adjacent to this battery of treaters is a building housing supplies of treating chemicals and six agitated chemical mixing tanks and their accompanying machinery for automatically proportioning chemical feed to the raw water. It is reported that this treating system is the largest hot-process softener in the world, and probably the largest industrial plant softener of any kind.

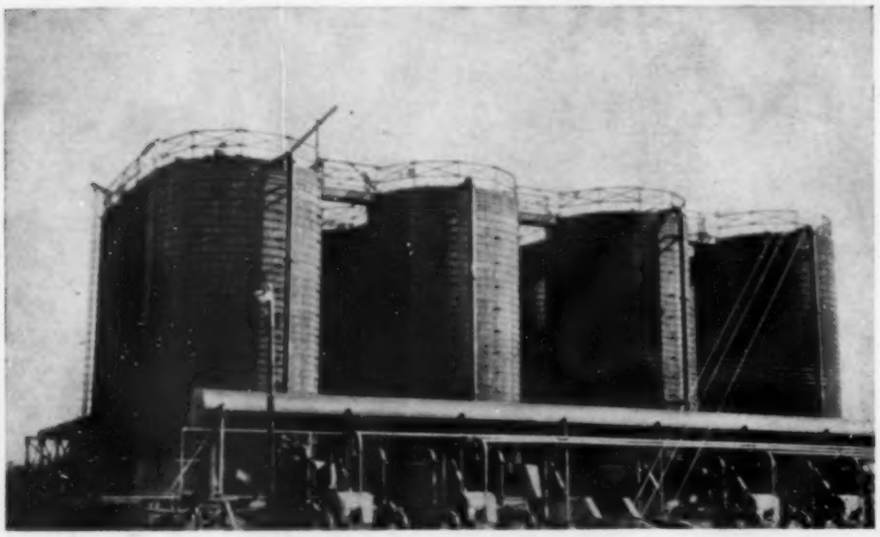
Feed water from the boiler-water softener is given an additional treatment before passing to the boilers. By means of the controlled addition of sodium sulphate and mono-sodium phosphate, the sulphate—carbonate ratio is adjusted to avoid caustic embrittlement as well as scale formation.

The principal need for live steam generated by the boilers is for superheating the so-called mine water which is injected into the sulphur deposit. After raw water has first been passed through the chemical treating plant, where it is preheated by exhaust steam, it passes through a battery of five turbine-driven centrifugal pumps to five high-pressure mine-water heaters, each of 75,000 gal. per hour capacity. These heaters are of the jet type, into which steam is introduced at boiler pressure. Water and steam enter separately and mix in the dome of the heater, bringing the temperature to above 300 deg. F. (usually 325 deg. F.), at which temperature the mine water is discharged through a second battery of five pumps into the insulated 16-in. main. From this main it is distributed to the wells and pumped into the sulphur deposit. This volume of water is likewise measured by recording orifice meters, which type of instrument is also employed to measure steam to the field. Temperature recorders give permanent records of the various temperatures of fresh water, boiler feed water, and mine water. The use of recording thermometers, pressure gages, and water, steam, and gas meters gives complete data from which the engineers in charge may check the performance of the various units and regulate operating efficiency.

Three steam-operated, two-stage compressors supply the air used in jetting the liquid sulphur from the wells. Air pressure of 500 lb. is maintained in the 6-in. field distributing line which is of sufficient capacity to eliminate the use of the usual air-surge or storage tank.

An interesting commercial-scale experimental plant for purifying spent mine water is now in partial operation. The customary practice is followed in this field, wherein the mine water is removed from the sulphur body through drainage or "bleeder" wells which are drilled to a deeper level in the surrounding area, solely for this purpose. Mine water returns to the surface at a temperature of about 180 deg. F. and carries a large quantity of hydrogen sulphide in solution. Former practice has been to aerate this water in an open ditch some 20 miles in length, thus purifying it before it is returned to the river, and such will be the practice until the success of the new purifying system is certain.



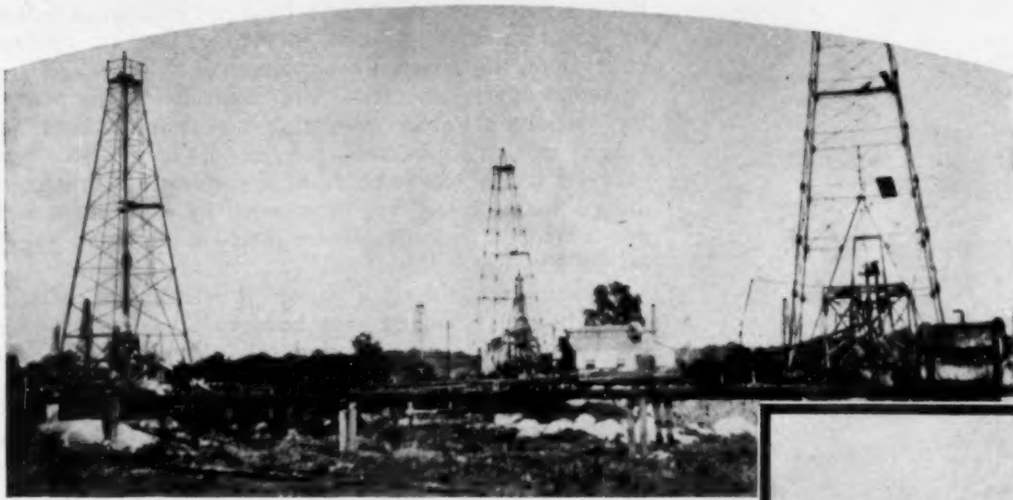


Koppers Experimental Purification Plant for Spent Mine Water; in View Above, Flue Gases Come From Boiler Plant in Steel Pipe and Return in Concrete Duct

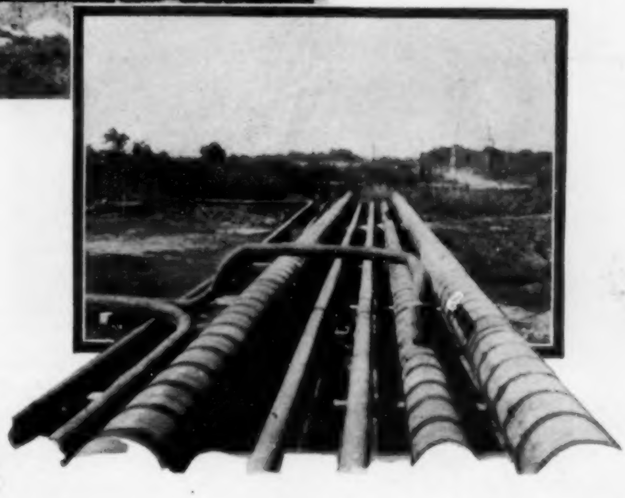
Boiler flue gases are used for stripping the H_2S in the new process. Gases are withdrawn from the breeching just ahead of the stack. This is done by means of turbine-driven blowers which force the flue gases through several hundred feet of metal piping about 3 ft. in diameter. When delivered at the purification plant, the gases contain about 8 per cent carbon dioxide.

Purification towers consist of eight redwood water tanks, inverted, closed at the top, placed over concrete basins, and filled with yellow pine baffles. The locally termed "poisoned" water is circulated in counter-current flow by motor-driven centrifugal pumps against the stream of water combustion gases to effect the removal of the H_2S. So far as is known, this is the only installation of its type. It is said that CO_2, being the more acidic, will effect purification of the water through the removal of the lesser acidic H_2S. The results of this work will prove of interest. The plant is a Koppers installation.

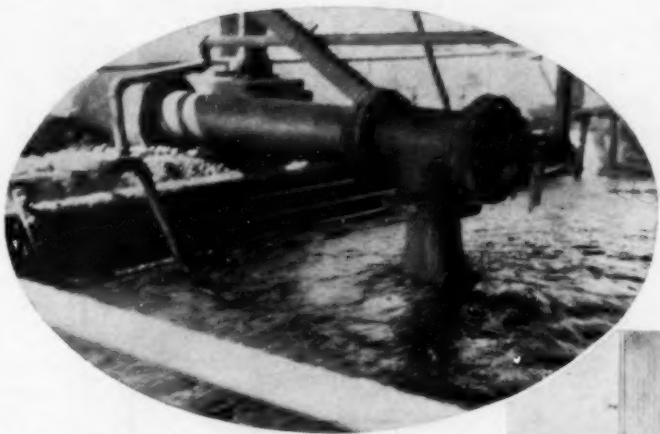
The mixture of cooled flue gases and the H_2S extracted from the water is taken back to the stack through an inclosed concrete duct. Here it enters the base of the stack through a rectangular aluminum flue gas duct. This becomes a false stack erected inside of the main stack, and extends upward to a point just above the flue gas breeching, through which the principal stream of furnace gases enter the stack. It has not been necessary



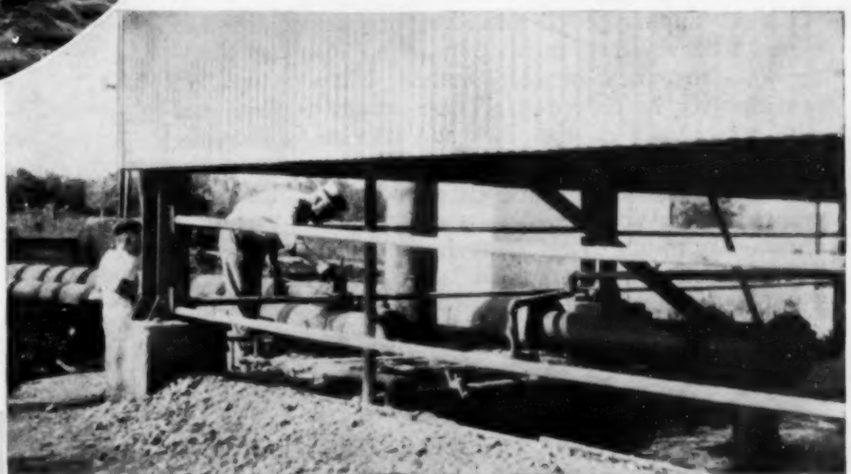
Group of Producing Sulphur Wells or Mines, With Field Relay Station in Background



Looking Along a Group of Lines Toward the Field; Insulated Lines Convey Steam, Superheated Water, and Sulphur; Other Lines, Air and Cold Water

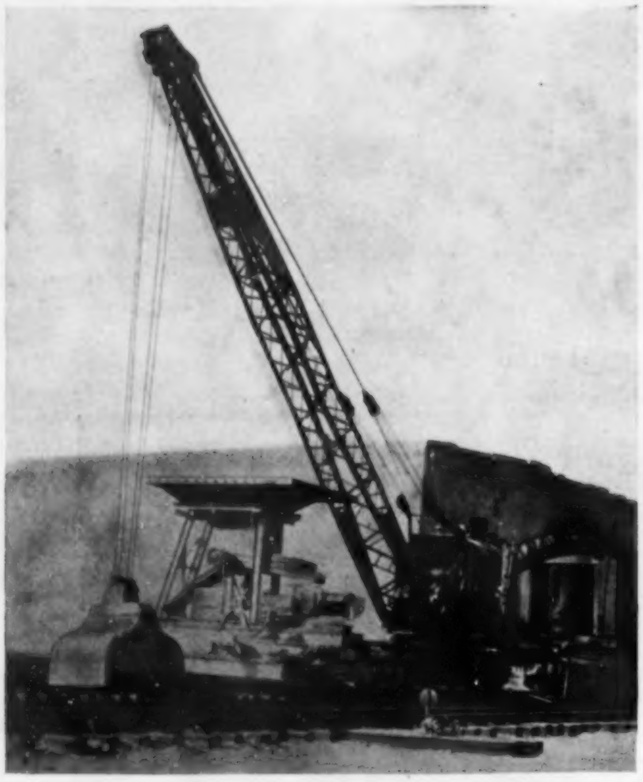


Molten Sulphur Pouring Into a Relay Station From Several Wells; Steam-Jacketed Centrifugal Pumps on the Floor Above Withdraw Sulphur to the "Vats"



Right: Looking Into the Tank of a Relay Station From the Outside; Pump Room Above

Left: Sulphur Storage; on Top of a "Vat" of Solidified Sulphur Before the Boards Are Taken Down; Size Is 1,200 x 160 x 50 Ft. High, Equal in Area to a Very Large City Block



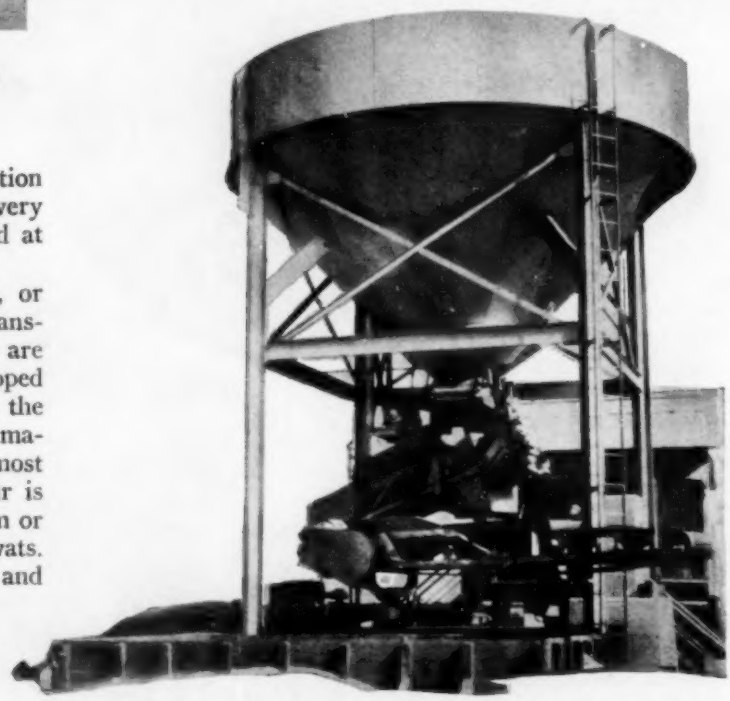
Sulphur Is Loaded Directly by Steam Shovel, or With Both Shovel and Hopper Conveyor

the moving parts are either submerged in liquid sulphur or steam jacketed, so that they may have no cooling effect upon the material being handled.

Actual mining operations are controlled at the pumping stations. Valves regulating hot water as well as steam and air lines, and sulphur discharge lines are grouped for the convenience of the operator. Best conditions for each well are determined by experiment and are controlled by conveniently placed meters and gages on air and water lines.

Sulphur from the relay stations is delivered to the vats through well insulated pipe lines in which is a small live-steam pipe for preventing solidification of the sulphur. These lines discharge directly into the vats, which are formed by the solidification of the liquid sulphur in a wooden bin. A few inches each day is added to the vats, until they reach a height of some 40 ft. Then the wooden sides are torn away, for the sulphur in the solid state requires no support.

Sulphur for shipment is blasted from the face of the vat as required, a vertical block from 12 to 20 ft. deep being removed at one time. Holes drilled back from the face of the vat at intervals are charged with powder and exploded, and the sulphur is broken into pieces of a size suitable for loading. Locomotive cranes with 2-yd.

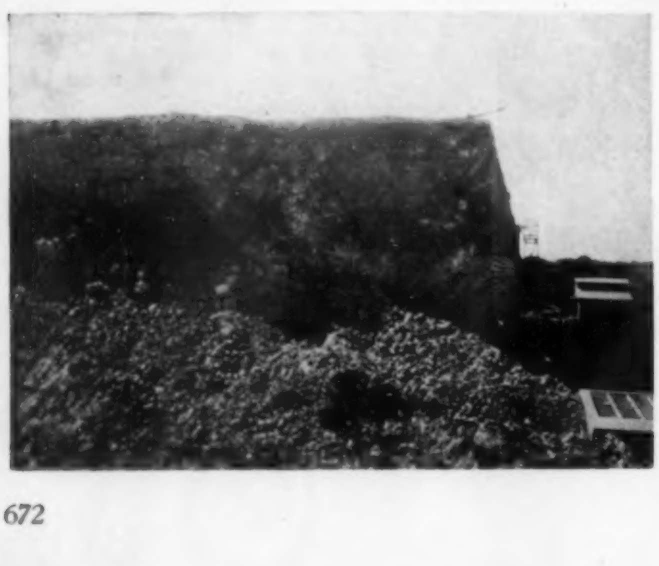


Weight of Loaded Cars Is Finally Adjusted at This Station by Steam Shovels and This Boom Belt Conveyor

to blow the gases back to the stack from the purification plant, since sufficient draft prevails to effect their delivery there. Fans for this purpose, however, are installed at the purification plant.

Liquid sulphur jetted from the producing wells, or mines, is conveyed through steam-heated, insulated transfer lines to a near-by relay station, where sumps are provided for its collection. These sumps are equipped with steam coils on the sides and bottom to keep the sulphur liquid. The lining may be of any suitable material, but cast iron has been found to be the most satisfactory. When the sumps are full, the sulphur is removed by means of centrifugal pumps, either steam or motor-driven, through sulphur pipe lines to the vats. The pumps are especially designed for this purpose, and

Sulphur Is Shot From This 400x600x50-Ft. Block, Ready for Loading Into Box Cars and Gondolas



clamshell buckets load the sulphur into box cars or gondolas. Box cars are loaded by means of hopper-conveyors, while the gondolas are loaded directly by the cranes. Before leaving the plant, each car is weighed and more sulphur added, or some removed, as the case may be, to meet proper weight requirements. Cranes and conveyors are installed for this purpose at the weighing station.

I am much indebted to H. E. Treichler, acting general manager for Texas Gulf Sulphur Company, for his permission to present a detailed discussion of his company's enterprise and for his co-operation in gathering material for this writing.

NEW SOURCES

Remaking the Gas Industry

By R. S. McBRIDE
Assistant Editor, Chem. & Met.

NATURAL GAS has invaded the city-gas business and overturned whatever complacency and self-satisfaction may have existed in this oldest of the public-utility businesses of America. Active, and hardly less potent, allies of natural gas are its own byproducts, propane and butane, and the amazingly large supplies of petroleum-refinery gas. These, with new technology in oil processing for gas enrichment, are rapidly creating an entirely new gas industry.

These facts, and many more equally revolutionary ideas, were the main theme of the twelfth annual convention of the American Gas Association, held in October at Atlantic City. That convention, and its accompanying largest exhibit of gas-making and gas-using equipment ever assembled, elicited superlatives, which seem not at all unwarranted. And, strangely enough, as the industry ceases to rest primarily on coal processing and the conventional methods of water-gas making it is becoming more and more, as characterized by President Mullaney, "a chemical industry." This change in type represents a difference in point of view and in method of attack on its problems rather than an advance in technology of gas production. Furthermore, it represents an industrial sales policy that promises to put city gas and its competitive gas contemporaries into virtually every factory in the country.

The methods by which natural gas has expanded to supply today nearly double the volume that was served only a few years ago, and the prospects of further expansion with another doubling in consumption for industrial and household purposes within a few more years, is a matter of greater importance to the chemical-engineering industries than might at first seem possible. The increases have been made under different circumstances in different parts of the country and it is essential to review briefly some of the outstanding developments of this character as reported to the convention in order to gain any comprehension of the significance for other fuel industries and for the industrial fuel users, among whom the chemical-engineering industries take a high position.

An outstanding development of the past year in the gas industry has been the invasion of natural gas, propane and butane, and refinery gas, supplanting or supplementing the customary coal gas, water gas, and oil gas of previous years. Naturally, the recent A.G.A. convention in every phase gave attention to this important and far-reaching development and its many technical and economic aspects.

Previously *Chem. & Met.* has reviewed, following the production conference and the distribution conference of A.G.A., much of the material from the carbonization, water-gas, chemical, and distribution committees. At this time we omit our customary review of these committee activities, since a very large percentage of the reports rendered during October were mere elaborations and revisions of the earlier conference preliminary reports. Those interested in the details of that work can obtain any wanted information by correspondence with A.G.A. headquarters. Preprints are available at this time to those needing them.

Barely two years ago it became evident that an adequate natural-gas supply was available at points from which it was economically feasible to bring this material into the San Francisco district. In October of 1928 the first big gas strike of the Kettleman Hills field district was made. On the basis of this and other near-by sources of gas supply, arrangements were promptly made for natural gas to replace oil gas in the Golden Gate area. The then existing gas load averaged approximately 1,000,000 cu.ft. of natural-gas equivalent per month. The potential load then served by other fuels was from two to two and a half times as great. The substitution was proposed on a gas-rate schedule that would offer prospective users gas at a lower rate per million B.t.u. than that prevailing for fuel oil.

Reporting on this situation, J. H. Gumz, of the Pacific Gas & Electric Company, stated that within one year from the time that the supply of natural gas became available, approximately 30 per cent of the total potential market thus estimated had been covered by contracts.

Projects of the character described for the San Francisco district, however, are not typical of most other parts of the United States which have thus far been reached by natural gas. The experience of Denver, summarized for the convention by George Wehrle, represents an entirely different sort of development. In that community there is comparatively little industrial activity in which the gas supply can hope to compete on a large scale with coal. However, natural gas has been successfully introduced and is effectively supplanting solid fuel for house heating. For that purpose it is estimated that the cost to a Denver householder is approximately 64 cents per million B.t.u. as burned. This is a figure just double the prevailing local rates for coal. The problem in this community has, therefore, been to secure house heating on the basis of improved efficiency of fuel use,

increased cleanliness and convenience, and the other advantageous characteristics of gas.

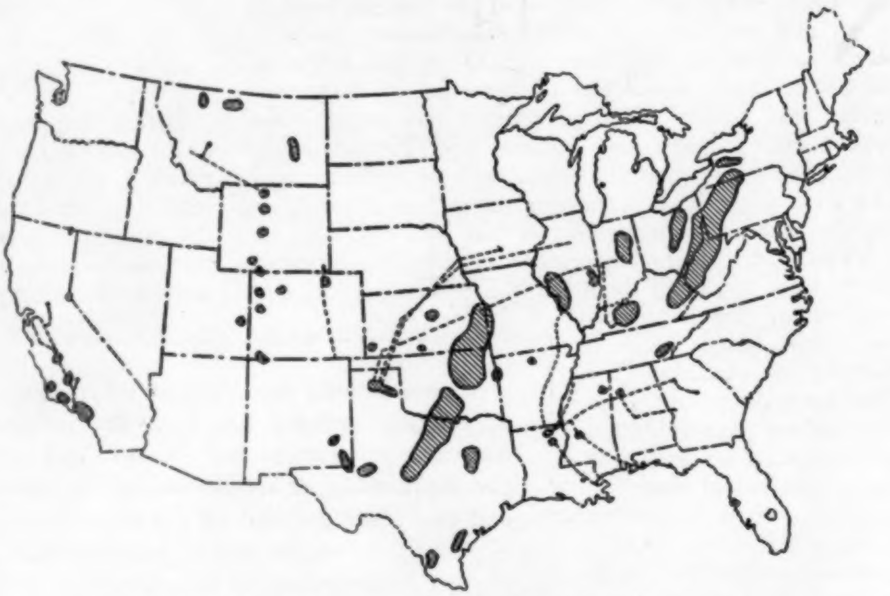
The experience of Denver in the substitution of natural gas for manufactured indicates some of the highly technical problems which must be solved. The gas as it reaches the city limits at high pressure must be saturated with water vapor and impregnated with an oil fog at the outlet of each of the high-pressure district-regulator stations. The water is introduced as steam with an automatically controlled device functioning under thermostatic regulation. The relative humidity of 75 to 90 per cent saturation at ground temperatures is maintained with suitable precautions against excessive moisture during cold weather, when freeze-ups may occur.

Present supplies of natural gas which have been tapped during the last year or two lie in northern Louisiana, the Panhandle of Texas, and the Kettleman Hills region of California. Numerous other large developments are being rapidly carried out. E. B. Swanson, chief economist of the division of petroleum economics of the Bureau of Mines, undertook to summarize some of the available data which relate to supply and demand for this commodity. He pointed out that at present between 60 and 70 per cent of the natural gas which is produced comes out of the ground in conjunction with oil. Hence the petroleum industry finds itself a vital factor in recent developments. Indeed, one prominent visitor to the convention apparently struck upon one of the most important questions now confronting the industry when he asked, And who is going to control this great industry?

Many of the pipe-line developments have been made as joint enterprises of utility companies with those petroleum corporations desirous of realizing some return from the gas which they inevitably must produce. These extensive developments have resulted in networks extending many times farther away from sources of supply than were thought possible only a few years ago. The general judgment of many participants in the convention proceedings who discussed natural gas is perhaps best summarized in a paper presented to the natural gas department by Robert W. Hendee, who speaks in the following language:

> The nation-wide use of natural gas and the growth of the industry has sprung up from a mere infant a few years ago to one of the major industries of today. Only a short time ago, it was deemed an engineering and economic impossibility to lay a natural-gas transmission line of over 100 miles. But in the last few years the distance natural gas has been transported has increased from 100 miles to 350 to 500 to 800 and now to 1,000 miles, and what will the limit be? As long as the market, a suitable reserve, and necessary finances are at hand, engineers will provide the needed pipe-line and compressor-station link between the field and the market. It does not seem unreasonable to expect, providing the tremendous fields continue to be developed in the Mid-Continent areas, that the near future will see huge transmission systems extending practically across the continent and linking one system with another for standby service, similar to that now maintained by the power companies.

Natural-gas developments for city supply on sound engineering and economic bases doubtless will prolong the life of gas fields and contribute more or less definitely to the productivity and the total recovery of oil simultaneously occurring. For this reason engineers of the petroleum industry are welcoming most cordially the stabilizing influence of the utility and pipe-line user. The producer of natural gasoline views this development with mixed emotion, and the manufacturer of carbon black with considerable concern. Swanson points out in respect to the last factor that only 60 per cent of the Monroe field production was burned for carbon black making in 1929, a definite decrease from the 90 per cent so wastefully applied just a few years earlier. This again emphasizes the inevitably migratory nature of the carbon-black business and its prospective early departure into the Texas areas, which are less accessible for pipe-line transmission.



Principal New Gas Areas and New or Projected Pipe Lines

That there will be a prospective shortage of carbon black resulting from this seems highly improbable. It would seem entirely possible for that industry to find ample raw material for its operation, even on the present highly inefficient basis, in the Panhandle of Texas alone. In that area it is estimated by this government official that not less than 500,000,000 cu.ft. of gas is daily blown into the air.

These figures and others presented as a result of the gas studies indicate a probable minimum life of the present fields of from 25 to 35 years. An interesting sidelight was expressed by one commentator who pointed out that practically every important pipe line thus far built or projected passes over or very near to a coal field. This engineer forecast an indefinite use of these pipe lines for the transmission of gas generated in these coal fields and transmitted through the pipe lines whenever such time may be reached that the waning supply of natural gas proves inadequate to supply the demand in areas to which they go.

COSTS and prices for natural gas have been widely discussed in the industry. Reporting for the committee on economic and engineering survey, R. G. Griswold called attention to the very low value in the field

of natural-gas supplies. In this connection he said: "How plentiful natural gas is, is illustrated by the fact that it has been sold for 2 cents a thousand on contracts, when it could be sold at all. This is equal to 50 cents a ton for coal or 3 mills per gallon for oil. Such cheap material in such large quantities, together with a period of easy financing, has started what may continue to be a long period of exploiting the long-distance transmission of natural gas."

LONG-DISTANCE transmission of natural gas has introduced no fundamentally new engineering problems, but has necessitated a new economic analysis of the units which make up a complete 1,000-mile system. Discussing this question, Edgar G. Hill and George I. Rhodes analyzed independently the several groups of factors, including: (a) those primarily dependent on length of line, (b) those dependent on the diameter of the pipe, (c) those dependent primarily on the weight or thickness of the pipe, and (d) those which depend on the number, installed capacity, and character of the compressing stations.

Among the most important conclusions which they express is probably the one convincingly demonstrated, that "long-distance transportation of natural gas does not necessarily involve higher pressures." Their cost studies demonstrate exactly how the engineer can determine with considerable precision the optimum number of compressing stations for any given length of line, the optimum maximum pressure for the line, and the probable total investment cost and its variation with the major factors involved. From the typical conditions reported it appears that one may expect under average conditions that a compressor station, recompressing the gas to at least 300 to 350 lb. will be required about every 100 miles. The cost of such compressor stations on typical modern lines is $100,000 each. The capacity of lines, typically from 16-in. to 24-in. diameter, is from 40,000,000 to nearly 200,000,000 cu.ft. of gas per day, requiring investments of from $25,000,000 to $75,000,000 and using transmission maximum pressures of the order above mentioned.

Apparently with alloy-steel tubing and the superior quality of welding and coupling joints now feasible, transmission pressures can safely be figured from 600 up to even 1,000 lb. per square inch as a maximum. According to these engineers, however, it is apparently too soon to assume that the higher pressures named are economically sound except under a limited number of present conditions.

In this connection it is of interest to note that one other engineer, not speaking formally on the convention program, gave as a generalization 2.5 cents per 100 miles per 1,000 cu.ft. of gas transmitted as a typical cost figure for long-distance gas handling. On such a basis the line of approximately 1,000 miles running from the Panhandle of Texas to Chicago could take gas worth from 5 to 8 cents per M and deliver it at the city limits for about 25 cents per M, making the total delivered cost from 30 to 33 cents per M, which is, as it happens, about 30 cents per million B.t.u. This cost figure assumes 100 per cent capacity load for the transmission line, a condition that cannot be maintained unless the natural gas is used merely as a base-load supply and variations in consumption demand are made up by other processes; for example, with water gas admixed with the natural.

Utilization of petroleum-refinery gases is now practiced in a number of important cities for enrichment of water gas or mixing with water or coal gas used in city supply. In some cases refinery gas requires a re-forming operation. In other cases it is used after purification merely as an enricher. Similarly, the importance of propane and butane is increasingly recognized by several contributions to the convention proceedings. The following statistics bearing on this question were summarized by J. A. Perry.

	Million Barrels
Crude oil production in the United States, 1929	1,006
Gasoline consumption, 1929	444
Gas and fuel oil used by gas industry	24
Refined gas-oil demand	17

The magnitude of the liquefied petroleum-gas business, as a byproduct of the natural gasoline industry, also was summarized with the following data:

	Million Gallons
Potential daily production	13
Actually and immediately available daily	1.5
Portion at plants large enough to justify recovery	50% of above
Total annual supply estimated	4,750
Production marketed in 1929	10
Estimated produced marketed in 1930	25

The importance of these developments as a prospective competitor of the gas industry was indicated by the committees' report in the following comparison:

> Tests show that the relative costs of heating with butane and gas in many operations in industries will permit butane to replace gas on a B.t.u. basis. The cost of butane will include the f.o.b. charge at point of shipment, plus freight, fixed charges on storage and conversion equipment, and some labor costs. The fixed charges will vary from 12 cents to 2½ cents per million B.t.u., for a heat use ranging from 500,000,000 to 2,000,000,000 B.t.u. per month. Butane is, therefore, a serious competitor for industrial gas when available at a suitable price.

BUTANE prices recently reduced have encouraged analysis of the new markets, not only of this liquefied gas but also of gas-burning appliances and equipment. R. W. Thomas, of Philfuels company, presented statistical analyses of this potential market and the prospects of gas development in towns too small to warrant independent gas plants and apparently not to be reached by natural-gas transmission lines. This estimate indicates that at least 14,000,000 households are now depending on fuel of low form value for which either bottled propane or small-town systems using butane would be desirable. It is estimated that of this total number of households, a population of at least 6,000,000, requiring nearly 1,300,000 customers, should be regarded as a sound prospect for this propane-butane development, independent of city-gas systems.

This new low-price level for butane, however, is not so welcome when this fuel offers to invade the field of process heating or factory-energy supply in territory reached by a city-gas system. Under such circumstances, the butane is about equivalent to city gas at 37 cents per 1,000 cu.ft., a price which can rarely be offered by the city-gas company, even to its larger industrial users. Furthermore as indicated by Griswold's comment already quoted, the industrial company desiring to use butane can arrange to do so with a very nominal new investment, often only $4,000 for a high-pressure storage tank. It is in this field of industrial fuel service that the gas man anticipates the most serious competition from liquefied hydrocarbon byproducts of natural gasoline.

CARBON TUBES

Offer Advantages in Cottrell Units

By A. D. CAMP
*National Carbon Company, Inc.
Cleveland, Ohio.*

A RECENT development in the field of materials for chemical engineering equipment has been the adaptation of carbon tubes to Cottrell precipitating units operating on highly corrosive fumes such as sulphuric, hydrofluoric, and phosphoric acids. This has come about because of the almost universal resistance of carbon to chemical action. Carbon is susceptible to attack only by oxygen at temperatures exceeding 600 deg. F., by oxidizing agents such as nitric acid, and by carbon dioxide and water vapor at comparatively high temperatures.

The chemical inertness of carbon combined with its high strength and the wide range of sizes and shapes in which it may be made makes it a suitable material for many forms of chemical apparatus under extremely corrosive conditions. New uses are developing as fast as methods are found for the production of the complicated shapes required by the chemical industry.

In addition to being chemically inert, carbon also possesses other valuable properties which make it particularly suitable for use in Cottrell precipitating units. These are its high electrical conductivity, its lack of a softening or melting point, and its extremely low coefficient of thermal expansion, which insures against breakage with sharp changes in temperature. Because of these properties, this material has become standard equipment for Cottrell precipitating units operating in sulphuric- and phosphoric-acid recovery.

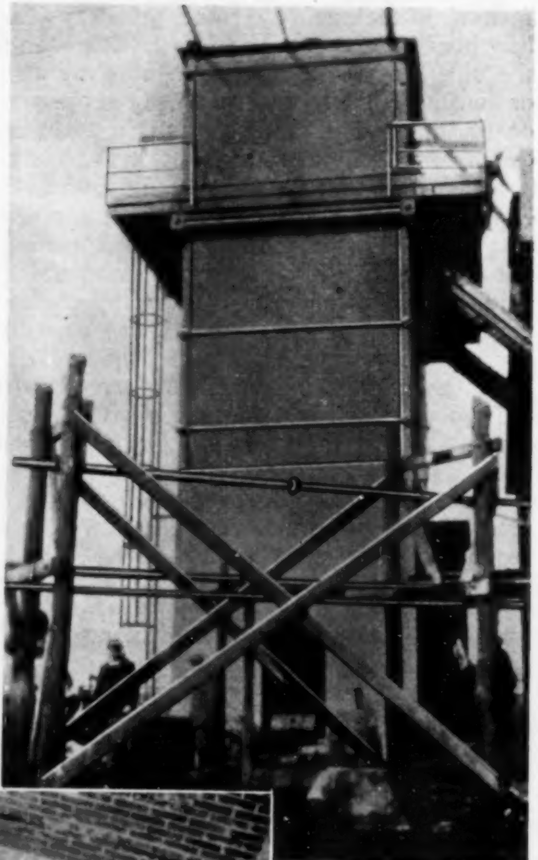


Fig. 1—Carbon Tubes in This Cottrell Precipitator Chamber Are Not Corroded by the Sulphuric Acid and They Do Not Sag Out of Shape as a Result of the High Temperature

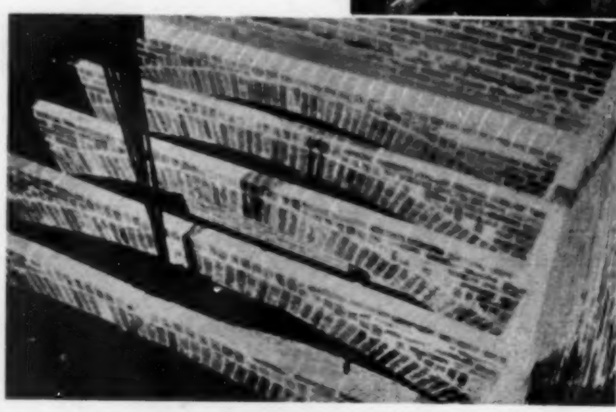


Fig. 2—Acid-Proof Brick Arches Support the Carbon Tubes in the Square Precipitator Chamber

In pyrolytic process phosphoric-acid plants, where phosphate rock is smelted in electric or shaft-type blast furnaces, the ultimate product is phosphorus pentoxide, a dense white fume which is most efficiently collected as phosphoric acid in a Cottrell precipitator. The presence of considerable quantities of hydrofluoric acid in these furnace gases has influenced the selection of carbon-precipitator tubes in this industry.

Contact sulphuric-acid plants operating on sulphur dioxide gas from zinc and copper smelters usually require Cottrell mist precipitators in the furnace-gas purification chain, where the presence of a number of highly corrosive elements makes carbon a very appropriate material for the fabrication of precipitator tubes.

The conditions are similar in drum-type sulphuric-acid concentrators, where dilute acid recovered from oil refineries and chemical processes is violently agitated by a blast of air at temperatures up to 1,200 deg. F. In these installations, carbon tubes are a great improvement over lead tubes, which corrode and sag out of shape at

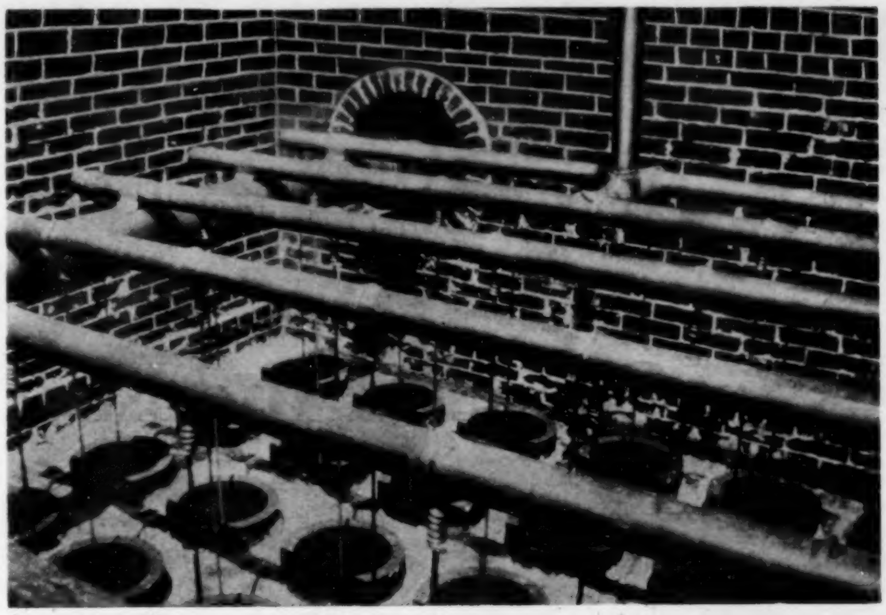


Fig. 3—Top of Tower After All Tubes Are in Place. A High-Tension Electrode Is Suspended Concentrically in Each Tube

Fig. 4—Carbon Tubes Are Suspended by Split Carbon Collars Which Span the Arches. These Collars Form the Ceiling of the Chamber

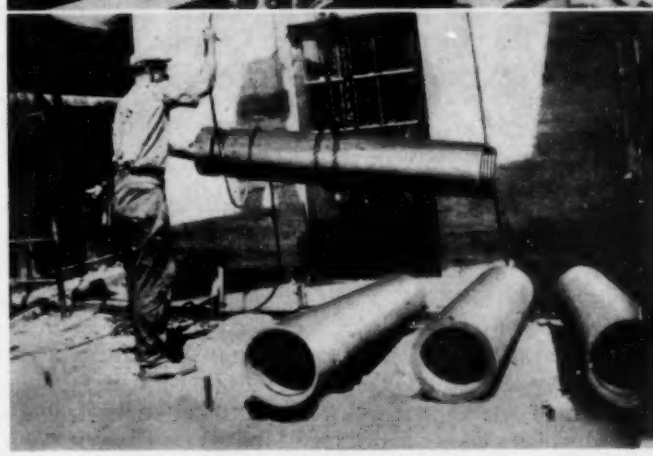


Fig. 5—Tubes Are 6 Ft. in Length With Threaded Joints. Sections Are Joined by Lowering the Upper Member Upon the Lower by Means of a Block and Tackle

the high temperatures involved. Cottrell tube deformation is a serious fault, since it throws the high-tension discharge electrodes off center and thereby induces arcing. This destroys the silent corona discharge, which is necessary for the efficient precipitation of the acid fumes.

A Cottrell precipitator is a necessary adjunct to a drum-type concentrator, in order to prevent an intolerable nuisance and an economic loss. The hot air in bubbling through dilute acid picks up, in addition to water vapor, from 10 to 15 per cent of the sulphuric acid, which would be discharged directly into the atmosphere if the precipitator were absent. The arrangement and operation of carbon-precipitation tubes in one of these units will be briefly described as a typical example.

The precipitator chamber, which is about 18 ft. high, can be either circular or square in cross-section. In the former, the carbon tubes are hung from lead-covered steel I-beams, spanning the top of the tower, while in the square chambers, the supports usually are acidproof brick arches. Fig. 1 shows the exterior of a typical square brick precipitator tower with the fume pipe entering at the upper right, while Fig. 2 is an interior view showing the brick arches.

Fig. 4 illustrates the method of suspending the carbon tubes. The split carbon collars or blocks spanning the arches fit into machined grooves near the tops of the tubes and hold them firmly in a vertical position. The joints between the carbon blocks are bonded with acidproof cement, so that the blocks actually form the ceiling to the chamber. Therefore, the only means of egress to the atmosphere for the concentrator fumes is upward through the precipitator tubes. Fig. 3 shows the top of the tower after all the tubes are in place with a high-tension electrode hanging concentrically in each tube.

Cottrell precipitators of this type are made in units of 36 to 72 tubes, which are usually 12 ft. long and range in diameter from $7\frac{3}{4}$ in. inside and $9\frac{1}{2}$ in. outside to 10 in. inside and 13 in. outside. The tubes are furnished in 6-ft. lengths with male and female threaded joints, as illustrated in Fig. 5. Two sections are readily joined by lowering the upper member upon the lower by means of a block and tackle, and screwing up the joint, while the tackle carries most of the weight of the upper tube.

There are now in operation in sulphuric- and phosphoric-acid plants 21 Cottrell units equipped with carbon-precipitation tubes, while 23 are working in connection with the recovery of sulphuric acid in oil refineries and chemical plants. After four years' continuous service in contact with hydrofluoric and phosphoric acids, carbon-precipitator tubes show not a trace of deterioration. Other chemical uses for carbon are developing rapidly, and when a variety which is impervious to liquids under hydrostatic pressure is available, the field for carbon in this industry will be greatly enlarged.

THEODORE J. KREPS

Professor of Statistics
Leland Stanford University

Tells How to Approach the Problem of

Joint Costs in Chemical Industry

While on the staff of the Department of Economics at Harvard University, Dr. Kreps completed some noteworthy studies of the economic development of the sulphuric acid and other chemical industries (see Chem. & Met. vol. 34, page 361, 1927). He now presents an interesting discussion of a problem peculiarly pertinent to chemical manufacture. His article is plea for quantitative knowledge in a field where rule-of-thumb and "good enough" have masked pitiful and costly ignorance. —Editor.

ECONOMISTS, like biologists and chemists, have frequently found it necessary to invent a technical jargon to describe things that are known by some name or other to nearly every one. Thus it may be that the term joint costs conveys to many chemical engineers but little if any meaning. Yet the phenomenon is present almost wherever chemicals are being manufactured. Except for such unit operations as crushing and grinding or drying, the making of chemicals usually involves the problem of disposing of joint-products, byproducts, or wastes. Thus electrolytic caustic soda and chlorine, hydrochloric acid and salt cake, acetic acid, methanol, and charcoal are respectively produced under the conditions of joint costs.

In scientific economic parlance, the phenomenon of joint costs is said to be present whenever a variation in facilities for putting out one of the products, or one group of products, necessarily brings about a variation in the facilities for putting out the other.

Joint costs must be sharply distinguished from overhead costs. It does not mean merely that a firm is making two or more products. The firm must be technologically compelled to do so. Many businesses find it profitable to put out side lines in order to tap fringe markets, but in so doing they never face the problem of joint costs at all. They distribute their overhead over a large volume of sales. But they are not faced with the dilemma: either to put out a side line or to incur the expense of disposing of a waste. A retailer of drugs may put in a line of photographic supplies in order to utilize his building and his own time more fully, or to furnish his customers with the means of satisfying all of a related group of wants. But he can drop the photographic business completely, or, if it be unusually profitable, devote to it more and more, if not all, of his energies. Not so the manufacturer of electrolytic caustic soda and chlorine. Whenever he produces more caustic soda, he has increased facilities on his hands for producing chlorine. Whatever option he has is limited to the choice of forms in which he will market the chlorine or the caustic. Thus though other industries may use their total facilities for two or more products because they want to, the chemical manufacturer often does so because he has to. The former is a case of overhead costs, the latter of joint costs.

Joint costs always mean, therefore, that a variation in the facilities for producing one article involves inevitably a variation in the same direction of the facilities for producing another. But the ratio of the respective rates of variation may either be definite and inflexible, or indefinite and variable. The former instance is called the case of joint costs with invariable proportions, the latter that of joint costs with variable proportions. If the facilities for putting out the main product are varied by any amount, Δx, and the amount of unavoidable accompanying variation in the facilities capable of utilization in joint or byproducts be represented by Δy, then the first type of joint costs obviously requires that $\frac{\Delta x}{\Delta y} = k$ when k is positive and a constant not equal to zero, whereas the second type permits Δy to be any positive function of Δx other than linear.

There are many chemical industries, such as the electrochemical and wood distillation industries, whose entire development has been shaped by the principle of joint costs with invariable proportions. They have been forced to market products whose exact cost of production they had no means of knowing. How is one to apportion costs as between caustic soda and chlorine, for example? To be sure, certain methods have been devised, but all are at best arbitrary, and yield cost figures that are no more than sophisticated guesses.

Suppose one uses such a basis as that of relative sales values of the products. Then whenever a competitor upsets the market by quoting a lower price, the cost figures for the industry become lower—on paper. Thus on paper the American costs of production of methanol went down over 10 per cent in 1925, as compared with 1924, simply because the imports of the article from Germany were accompanied by a greater fall in its price than that which happened to occur to the joint products, acetate of lime, and charcoal. On paper an increase of the tariff from 12 to 18 cents per gallon by order of the President under the flexible provisions of the tariff law ought to have enabled the American wood-distillation industry to adjust itself. Actually, of course, there existed no such

paper route to salvation. If the charcoal markets cannot stand a higher price, and if the domestic producers of synthetic acetic acid prevent any increase in the price of acetate of lime, the stubborn irreducible fact of joint costs threatens the whole industry with extinction.

The manufacturer who is faced by the fact of joint costs with invariable proportions should not let himself be guided too naïvely by his cost figures. They do have considerable value as tests of his manufacturing operations. They enable him to compare the performance of the present with that of the past, or with some standard or theoretically attainable performance. But they give him little if any help in his selling operations. Herein his business is entirely different from other businesses.

The main, if not sole, desideratum for the sales policies of a manufacturer who is producing articles under the conditions of joint costs with invariable proportions is that of making the composite of sales orders take off the products in the proportions in which they emerge from the factory processes. A cut in the price of one of them is not an independent act, to be based on considerations of cost figures for the item in question. It is rather a small strategic move in a highly complicated business campaign, the single movement of a squad as compared to the maneuvers of an army. Price quotations on any one item are shifted for the same reasons that one shifts pawns in a chess game.

The logical solution of the difficulty, beneficial to consumer and producer alike, is, of course, some form of agreement, merger, or consolidation. Since the individualistic economic forces of price determination lead only to chaos, particularly so where there is a multiplicity of options as to methods of production, there develops, in the measure that disaster threatens, an urgency to come to mutual agreement. Price and production cartels evolve into a community of interests, or into an exchange of fractional equities, sometimes even into an amalgamation. Trustification grows cumulatively until the whole of the chemical enterprise in each political area is dominated by one giant concern. Then the stage is set for international cartels, world price agreements, world allotments of sales territories, world patent pools, and the like. These are arrived at by processes analogous to those of international diplomacy. Tariffs, commercial treaties, patents, immunity from anti-trust legislation, absence of social legislation benefiting the workers, length of purse, etc., constitute the pawns or bargaining weapons; and the ultimate result is an agreement among all of the most important producers of the world.

The case of joint costs with variable proportions, as opposed to that just discussed, presents no economic problems that are wholly peculiar to the manufacture of chemicals, but it does present these problems in a wholly peculiar form.

Every business, for example, considers margins. Every manufacturer compares increments of sales values with increments of expense, rather than totals or averages. Every intelligent entrepreneur adjusts his volume of production or sales in such a manner that the derivative of aggregate net profits with respect to input expense is zero. This he does not only for the profits of the process as a whole but for the profits at each margin of variation; i.e. each of the partial derivatives is also made equal to zero. In other words, if the several influences of the variables of input with respect to profits are each represented by a vector, the shrewd business man adjusts the orbit of his manufacturing activity in such a manner that the resultant or diagonal of the vectors is a maximum.

Suppose he is distributing his own alkali. Obviously, it is not enough for him to know his total costs and total sales receipts, and feel happy if the latter are larger. He must be on the lookout for leakages at every point in his operations. He must compare the additional sales volume obtained by getting the business at Pumpkin Center with the costs of production, salesmanship, and distribution properly apportionable to that increment. By "properly apportionable," of course, is simply meant that the method of the differential calculus, or the logic of concomitant variation, is used. What would have been his volume of business without the sales in Pumpkin Center? What would have been his total expenses? What increment in sales value, what increment in expenses is due to getting the trade in Pumpkin Center? Obviously, if the increment in costs unavoidably exceeds the increment in sales, such business can very profitably be left to a competitor. Many American producers in their mad rush for larger volume, for bigness, have undoubtedly neglected this simple economic calculus, only to find themselves hard pressed by a smaller competitor. Every intelligent business man, in short, thinks in terms of margins, not averages.

In the chemical industry, however, wherever joint costs with variable proportions are present, such thinking is not only of paramount importance but it often involves computations of such elaborate complication as to require the development of a special managerial aide or department, a commercial and statistical research laboratory. Chemical processes can be varied in all those ways by which chemical equilibria can be influenced. When one remembers that chemical equilibria may be homogeneous or heterogeneous, and that the state of aggregation of the substances may be gaseous, liquid, or solid; when one considers, further, that the effect of such variables as temperature, pressure, homogeneity of mixture, concentration, surface energy, and current density involve a different set of differential equations for each combination of equilibrium and state of aggregation; and finally when one realizes that such technical computations must be modified by the appropriate price co-efficients to ascertain the actual or probable effect on profits of each type of variation—one understands why rule-of-thumb and "good enough" in the chemical industry must be supplanted by exact quantitative knowledge.

Finally, it may not be superfluous to point out that wherever joint costs are present, the ordinary so-called

ROBBING PETER TO PAY PAUL

is a dangerous practice in chemical costing where joint products are involved. Unfortunately, according to Professor Kreps, "there is a persistently reappearing crop of competitive neophytes who tend to upset the old stability in purely arbitrary fashion until they become skeptical of their own cost figures. The equilibrium of market and production arrangements, under which all could live and let live, tends constantly to be disrupted in the same purposeless, wasteful way that a beginner breaks up a bridge game."

laws of supply and demand do not hold true. Joint costs make it necessary for the executive to look out for unusual sources of cost variation, and prepare for unexpected causes of cost flows. Prices of the raw materials of an industry will fluctuate independently of its demand, even though they are not used elsewhere. For example, take chlorine in the old English Leblanc soda industry. Did its price or its supply vary with the demands of its consumers? Scarcely at all. Both depended on the production of soda ash. The price of bleaching powder often went down merely because there had been an increase in the demand for soda ash. Any change in demand, any invention of a new process, or any discovery of a new market for one of the joint products of a chemical business is thus bound to have repercussions on the price and supply of all the others.

The successful producer of chemicals must know the market conditions for a host of items which he himself never has sold, nor even intends to sell. He must be able to forecast somewhat the technical developments and possibilities in industries and processes wholly different from his own. In short, the peculiar importance of the principle of joint costs makes it necessary for the chemical business man to be exceptional in alertness, unusual in penetration of vision, and extraordinary in breadth of scientific, technical, and economic horizon.

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British Experience With Low-Grade City Gas

By NORMAN SWINDIN

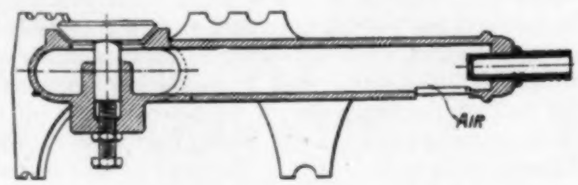
Consulting Chemical Engineer, London, England

THE NUNEATON low-grade town gas process is the work of George Helps, the manager of the Nuneaton Gas Company, who, by a fierce advocacy during the past twenty years, is entitled to the credit of being the British pioneer in the use of low-grade gas for town purposes. This development was based on Helps' demonstration that a gas having not more than 400 B.t.u. gross heating value when burned in properly designed appliances, gave better results than the higher grade gas of 500 to 600 B.t.u. under ordinary conditions of distribution and use. It depended also on the fact that low-grade gas could be manufactured in a simple form of producer with complete gasification of the coal if desired, or, if low-temperature producer were employed, a smokeless solid fuel could be produced instead of ordinary coke.

These developments have opened up the possibilities under British conditions of supplying town gas at a price to compete with coal for all purposes for which coal is now used. This revolution has proved too much for the gas industry in England, which up to the present has spent its energies in opposing all efforts to give the public cheap gas or smokeless fuel, but it is now showing signs of activity. It is collecting all the gas it can find from coke ovens and is selling it as high-grade gas. It is beginning to make low-temperature fuel, but this belated activity is only the prologue to the fundamental changes pioneered by Helps.

This article, advocating the recent British policy of low heating-value gas with special burners for industrial service, encourages renewed attention to numerous fuel-supply problems. It is not published with the idea that the recommendations are directly applicable to American conditions. In our judgment they are not all suitable for adoption unmodified. They are, however, of sufficient importance to justify thoughtful consideration.—*The Editor.*

Helps' gas-utilization proposal, now firmly established by large-scale experience, is based on appreciation of the importance of flame contact obtained with low-pressure gas with coneless flames, and a realization of the fact that inerts, in the form of N_2, are of little consequence. This means, converted into a slogan, "One B.t.u. is as good as another." It is true largely because



Helps' Burner for Low-Grade Gas

of the fact that the calorific value of the completely aerated mixtures of gas and air for all combustible gases from 500 B.t.u. down to 180 are practically the same. Gas of 500 B.t.u. cannot be properly burned at the usual pressures in the usual type of atmospheric bunsen burner.* Most of the oxygen for its combustion must be obtained from the outside atmosphere, because the energy of the jet is not sufficient to draw in all the required air into the mixing tube of the burner. Thus we get long flames with the green cone, which is itself really a subsidiary gas works and a retarding of the rate of combustion. With 200 B.t.u. gas, containing, say, 50 per cent of nitrogen, we have energy at the jet to draw in all the air for combustion so that a coneless flame is formed which can be brought in close contact with the vessel to be heated.

With Helps' burners the kettle is only $\frac{1}{16}$ in. from the burner head. So complete is the aeration that a Helps flame burns freely in an atmosphere of CO_2 and nitrogen and, if the pressure be sufficient, the burner can be plunged in water. In other words, it is air that is really burned, and to get this into the burner requires energy. What Helps has done with his 200-B.t.u. gas is to give each consumer an automatic pump. To give an electric analogy: the high-grade gas works send out only the amperes but no volts. Helps sends volts also; and volts times amperes is energy.

The illustration shows the construction of a Helps patent burner from which it is seen that the regulation is made by adjusting the burner head and not tampering with the jet or the tap. The adjustable cone is fixed so that the gas does not strike back. The speed of propagation of flame in 200-B.t.u. gas is approximately 3 ft. per second, so that the velocity of the mixture in the combining tube of the Helps burner, illustrated above, must exceed this speed.

*This statement may be subject to considerable question.—The Editor.

Ammonium Sulphate Made By New Processes

IN GERMANY, two processes have been developed recently in which the sulphur recovered in purifying the coke-oven gases is utilized in the production of ammonium sulphate. It is claimed for the Tern and Cyanogen-Ammonia-Sulphur (C.A.S.) processes that the cost of producing this byproduct will be materially lowered. In both processes the essential cost-saving is the elimination of the purchase of sulphuric acid.

The operating layout of the Tern process, of the Thueringer Gas-Gesellschaft, Leipzig (Special Circular No. 301, chemical division, U. S. Department of Commerce), shows the usual apparatus for separating tar and ammonia from the gas, by cooling and washing, but then it leads the aqua ammonia to a special container, where its tar content is further reduced, and distilled with steam. The ammonia is then expelled from the solution, dried, and stored.

Gas is desulphurized in oxide boxes by use of the usual iron hydroxide. The spent oxide is then roasted in a special furnace, whence the gaseous sulphur dioxide driven off is led to a storage chamber and oxidized in the presence of an electric arc to sulphur trioxide. Two gaseous compounds NH_3 and SO_3 are then led in the proper proportions into a reaction chamber and are combined to form dry ammonium sulphate crystals, sufficient moisture being present in the atmosphere to hydrate the sulphur trioxide. The reactions chamber is equipped with an electrical precipitator. Ammonium sulphate thus formed is dry and enters the trade as so-called "Electro-ammon."

Data as to production costs are lacking, but it is stated electric energy consumption is low and that the sulphuric-acid cost-saving more than justifies the process. It is understood that plants are proposed to produce 37,000 tons of ammonium sulphate annually.

Raw gas from the coke ovens is led through a water cooler and tar separator, respectively, and then drawn by suction through a washing plant that frees it of ammonia, hydrogen sulphide, and cyanogen compounds. The tar-ammonia water mixture from the water cooler is collected in a separate chamber, where the tar is drawn off while the ammonia water is led to a storage chamber, whence it is concentrated to be finally passed to the washer. The circulating washing liquors here are partly led to a regenerating chamber, while another part is brought in contact with sulphur dioxide from appropriate furnaces to form ammonium poly-thionate, which is autoclaved to ammonium sulphate and free sulphur, the latter being drawn off in liquid form. The hot 50 per cent sulphate liquor is evaporated and crystallized.

Part of the sulphur is employed to produce sulphur dioxide, while excess sulphur is sold as such. Generally, more hydrogen sulphide is present in the gas than needed to form ammonium sulphate. In cases where coal is low in sulphur the plant must be hooked up with a pyrites-roasting furnace.

An experimental plant operating this process was built in connection with a Westphalian gas works in 1928, and has been in production since the beginning of 1929. The first large-scale plant of this kind, for processing 600 tons of coal daily, is ready for operation at the coke plant, Georgeschact of Obernkirchen. It has been stated that a coke plant operating 1,000 tons of coal daily by the C.A.S. process reduces production costs of ammonium sulphate by $22.44 per ton compared with ordinary by-product ammonium sulphate. These figures are based on German conditions and German prices and may not apply in the United States.

Heinrich Koppers summarized the economical advantages of the C.A.S. process (*The Gas World*, Dec. 7, 1929) thus: (a) One ton of sulphuric acid of 144 deg. Tw. is saved per ton of sulphate made. (b) There is an additional yield of 10 per cent of ammonium sulphate. (c) The high cost of the dry-gas purification is saved —under conditions in Germany a saving of at least R.M. 30 per ton of ammonium sulphate by this item alone. (d) Excess sulphur can be sold for commercial purposes. (e) The process works in a semi-direct manner and the cost of steam is very low. It also has the advantages of the Koppers semi-direct process. Cost of operation through the year is low and not higher than those plants built on the semi-direct lines, including the oxide purification.

A MEMBER of the ammonia committee of the Institute of Gas Engineers, E. W. Smith, in an article in *The Gas World* (Feb. 1, 1930) discussed the C.A.S. process from the viewpoint of Great Britain. He called attention to the following facts: (1) There is already a very simple and reliable process of making ammonium sulphate in a single piece of apparatus, known as a saturator. (2) There is, at present, a ready market for any sulphur extracted from gas, in the form of spent oxide. (3) As the result of the great development of sulphuric-acid plants during the war and the growth of the smelting industries, there is a surplus of sulphuric acid in Great Britain. (4) For the operation of the C.A.S. process, the following equipment is necessary (all of which is replaced by a saturator and neutralizer in the process of semi-direct recovery with H_2SO_4 devised by Dr. Koppers, which has had such world-wide success): (*a*) Ammonia concentration plant; (*b*) four hurdle scrubbers; (*c*) final scrubber; (*d*) aerating apparatus; (*e*) sulphur dioxide production plant; (*f*) sulphur dioxide reaction vessel; (*g*) filter press; (*h*) sedimentation plant; (*i*) pressure decomposer; (*j*) vacuum evaporator. It may be claimed that all this apparatus is not required for the production of the SO_4 radicles, but the fact remains that a complete, balanced process is necessary, or the whole scheme falls to the ground. That is, unless cyanide be removed in the early stages, or excess sulphur removed in the later stages, the chemical balance would be upset.

Expressed briefly, the coke-oven plant or gas works which works the C.A.S. process really enters into competition with the sulphuric-acid manufacturer in the production of SO_4 radicles. On a small-scale plant he has to compete with large-scale plants.

Without wishing to convey the impression that sulphuric acid is being sold at rock-bottom prices in Great Britain, it is believed that the SO_4 radicle as purchased in H_2SO_4 is the cheapest form in which it can be obtained in Great Britain today and, taking all costs into consideration, the SO_4 radicle produced by the C.A.S. process, if operated in Great Britain, will be more expensive than the SO_4 radicle purchased on the open market as H_2SO_4.

Lignite and Ceramics Dominate Research at North Dakota

By IRVIN LAVINE
Assistant Professor of Chemical Engineering, University of North Dakota, Grand Forks

School of Mines at University of North Dakota

A. W. Gauger, Director of School of Mines

DEVELOPMENT of the resources of the state has long been the interest of the School of Mines at the University of North Dakota. Various phases of this problem have been studied, first under the direction of the late Dean E. J. Babcock and later under his successor, Dr. A. W. Gauger, the present director. It is the purpose of this paper to describe the work that is being continued at the present time under the direction of Doctor Gauger and his associates, and to indicate the importance of this work to the future of the Northwest.

The course of chemical engineering, which had its inception in 1926, was started primarily in answer to the demand of industry for men well-versed in the fundamentals of chemistry, physics, mathematics, and engineering. The curriculum follows, in so far as possible, the standards of the American Institute of Chemical Engineers. Beyond this, it is the aim of the department to acquaint the student with the principles of industrial research.

In the sophomore year, the department of chemical engineering offers a course called "Industrial Engineering Chemistry" to students in all branches of engineering. In it the fundamentals of physical chemistry, chemical engineering, and analytical chemistry, have been combined to form a source of valuable information for the young engineer; obviously, it serves only as an introduction to the student in chemical engineering, who in succeeding years covers these fields more thoroughly. It has also been found advantageous to have the junior and senior students assist, under careful supervision, in the various research problems that are conducted during the school year.

IN CORRELATING the research at the university with the peculiar resources of the State, the factors taken into account deserve a brief exposition here. That there exists a serious fuel problem in the Northwest has been realized for some time. Hood and Odell (*Bulletin 255*, U. S. Bureau of Mines, 1926) in their lignite investigation sum up the situation as follows:

> "The nation's coal resources of all grades are estimated to amount to more than three and a half trillion minable short tons. Nearly one-third of this is lignite, and more than nine-tenths of the lignite is found in North Dakota and adjoining sections of Montana and South Dakota. The section of the country which contains almost one-third of our entire coal resources is the most neglected part in the development of fuel resources. The proximity of this section to the Great Lakes, which afford a relatively cheap means of transporting fuel from the Eastern coal fields into the Northwest, has contributed to the present situation."

It can be seen, therefore, that it is a matter not only of interest but also of great practical importance to study the characteristics of this fuel with a view to working out a method of improving its heating value at a profit.

The State of North Dakota alone, then, possesses 600 billion tons of lignite confined entirely to the western half of the state, where the workable beds are included within an area of approximately 28,000 square miles. The moisture content of this fuel, as mined, ranges from 32 to 43 per cent. Upon exposure to the atmosphere lignite dries to an extent that depends upon the humidity and temperature. However, in this drying process there occurs considerable checking and cracking which results in the formation of much slack. In consequence the profitable shipping radius of lignite is lim-

ited and transportation must take place in closed box cars. On the other hand, the whole state of North Dakota is covered with deposits of clay which vary in thickness from a few hundred feet in the Red River Valley to several thousand feet in thickness near the western part of the state. Included in these deposits are a large number of different kinds of clays ranging from common brick clay to deposits suited for the production of a very high grade of art pottery.

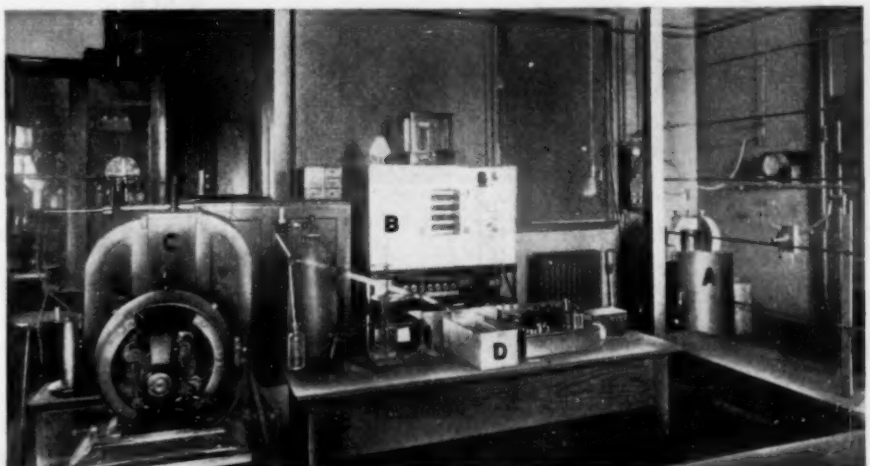
EARLY investigations conducted at the School of Mines, indicated the very high quality of the clay found within the state. It was thought advisable, therefore, to provide suitable facilities for studying the characteristics of these deposits. As a result the ceramic department of the School of Mines was established in 1910 for the two-fold purpose of "providing courses of instruction in the ceramic art and for carrying on a research program to develop these deposits."

The chemical and experimental laboratories of this department have been well equipped for clay testing, and the clay working laboratories have been provided with standard types of machinery for actual production by the same methods as employed in the various lines of ceramic industries.

At present writing the work of the ceramic department can be divided into the following phases: (1) The work of producing various kinds of ceramic ware is being continued. This work may mean the establishment of industries to manufacture products not yet produced in the state, as well as shipping of prepared clay for use in industries outside the state. (2) A survey is being conducted to determine the clay requirements of the industries in the Northwest. There are many plants in Minnesota and adjoining states that import yearly several thousand tons of kaolins from Georgia and other Eastern states. The work of this survey includes field trips to locate deposits that can meet the specific requirements of these industries. (3) For the past three years, the department has been determining the P_H of slips made from Dakota clay. This is the first step in the detailed study of the physical chemistry of this material.

Dakota lignite was originally studied by the late Dean Babcock, who with his students and assistants, worked out the fundamental principles of a carbonizing and briquetting process. This process is capable of producing at the mine a high grade of domestic fuel, capable of withstanding the handling and storage difficulties ordinarily encountered with non-processed lignite. Production of carbonized briquettes has not been developed, however, to a point where this product can compete commercially with Eastern coal, due largely to present-day conditions.

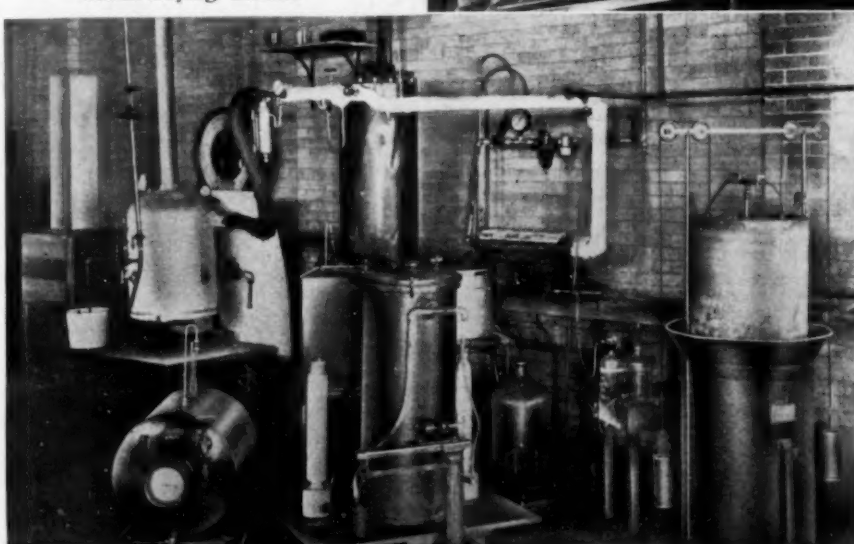
It was therefore obvious to the present director, when he assumed his duties in 1926, that other lines of investigation would have to be undertaken. Since every plausible clue was to be followed, many problems were started with the understanding that as the work progressed only that indicating a probable success would be continued. At present the following phases are being studied:



Above—Laboratory at the School of Mines

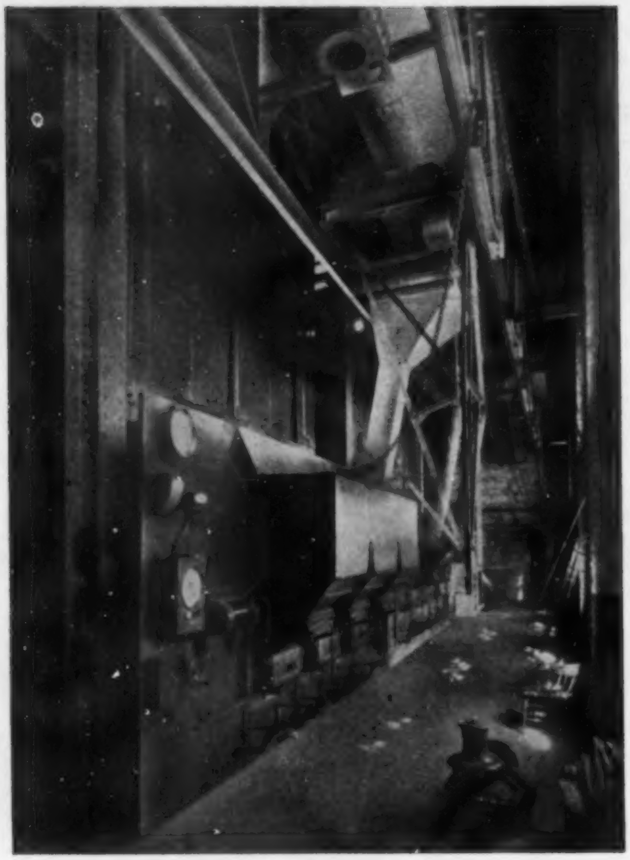
A—X-Ray Machine; B—Humidity Dryer; C—X-Ray Machine for Radiographic Work; D—Apparatus for Determining PH of Clay Slips

Below—Apparatus Used by Writer in Steam-Drying Studies



Coking—Lignite is a non-coking coal and obviously this limits its use for gas-making. One of the early studies started by the present administration was to determine the effect of certain inorganic salts on the carbonization of Dakota lignite in an effort to convert, if possible, this fuel to a coking material (Gauger, A. W., and Salley, D. J., *Int. Conf. Bit. Coal,* Vol. 1, 312-328, 1928). Early results indicated that such salts as $AlCl_3$ and $Al_2(SO_4)_3$ produce a marked effect on the carbonization process. In fact, it was found possible to produce a pseudo-coke. This study has been continued and the results have led to a better understanding of the coking process.

It has become apparent to fuel investigators that the structure of coke must be studied by methods other than



Power Plant at University of North Dakota Using Pulverized Lignite

chemical. Of late X-rays have come to play an important rôle for this purpose, and are now used as part of the equipment for carbonization study at the School of Mines.

Pulverized Lignite—The use of pulverized lignite for steam generation has been made a subject for study by the School of Mines. This work is being conducted at the University power plant, which necessitates commercial-size equipment. Early experiments have indicated that pulverized lignite can be efficiently used in power plants (Sutherland, R. L.; Bourke, N. T.; and O'Keefe, E. J., *Power,* June 26, 1928). The work is to be continued to determine the relative value of pulverizing lignite, with and without separate drying in a waste heat drier. In the University power plant, lignite is the only fuel used in generating steam.

Drying—Attention has already been called to the fact that lignite is characterized by a high moisture content and that on exposure it disintegrates or slacks. The high moisture renders some form of drying necessary if the freight handicap is to be eliminated. It was obvious that a satisfactory drying process might lead to a practical solution of the problem.

Working out a satisfactory drying process is a chemical engineering problem of great complexity involving many smaller individual problems. The first logical step is a study of the fundamental characteristics of the moisture in the lignite and one feature of this study has been the determination of the aqueous tension of the moisture in lignite. The results so obtained have been of material aid in determining the probable mechanism of any drying process for lignite. Furthermore, the results also emphasized the colloidal character of Dakota lignite. A further indication of this colloidal character has been obtained from microscopic study of thin sections of lignite.

Any successful method of drying lignite with a minimum of disintegration will have to dry the entire lump at a uniform rate. We may consider the drying to take place in two stages, namely, the transfer of moisture from the interior to the surface, and secondly the evaporation of water from the surface. The rate of loss of moisture from the lump will evidently be governed by the slowest step, which in the case of lignite is the transfer of moisture from the interior to the exterior. In order to obtain the ideal drying condition which minimizes degradation it will be necessary, therefore, either to slow down the rate of evaporation of moisture from the surface, or speed up the rate of transfer of moisture to the surface.

The first process referred to above involves slowing down the rate of evaporation from the surface and necessarily will have to be accompanied by accurately controlling the humidity of the drying medium. This process may, therefore, be termed "humidity drying." The mechanism of the "humidity-drying" process for lignite is being studied on a small scale with a Carrier standard humidity cabinet. Lignite is dried in this apparatus under constant conditions of humidity and temperature with a view to determining the rate of diffusion of moisture. The effect of drying lignite in atmospheres of varying humidities as well as temperatures is also being studied.

This process is being further studied on a larger scale with a direct-contact drier of semi-commercial size installed in the power plant of the University. Waste stack gas obtained from the burning of lignite in the power plant is used as the drying medium because it is exceedingly rich in moisture. The humidity of the drying gas can be controlled by mixing definite portions of the entering stack gas with portions of the exit gas from the dryer (Lavine, Irvin, and Sutherland, *Chem. & Met.,* 36, 425, 1929).

When this work was started it was discovered that existing psychrometric charts had a temperature range that was not sufficiently high to be of any assistance and consequently it became necessary to construct a chart suitable to the needs. This chart was published in *Chem. & Met.* (35, 224, 1928) and has not only been found most useful in this work but has also aroused much interest outside.

The second method of drying calls for an increase in the rate of transfer of moisture to the surface. The Fleissner method of drying Austrian brown coal (*Trans. Fuel,* World Power Conference, 1928, Vol. 1, 328-340) seems to fulfill the conditions required. In this, the coal is thoroughly heated by means of saturated steam at elevated pressures; drying of the lignite is obtained first by releasing the pressure and then by means of air passed over the hot coal. Early experiments at the School of Mines indicated that Dakota lignite could be successfully dehydrated by this method. During the past year, the writer studied this process in detail (*Ph. D. Thesis,* Univ. Minnesota, 1930) and this work is still being continued.

The success of the steam drying process for Dakota lignite will depend largely on the utilization of all the available heat put into the system by the steam. In order that a heat balance of the process might be made, it became necessary to determine the specific heat of lignite with varying water contents. This is another study that is being carried on at the present time.

Furnace-Testing Refractories For Slag Erosion

By B. W. STROMBERG
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SEVERAL INVESTIGATORS* have designed laboratory apparatus for the testing of refractories against slag erosion. In order to be successful, such an apparatus should consist of a slag test furnace, the requirements of which should be:

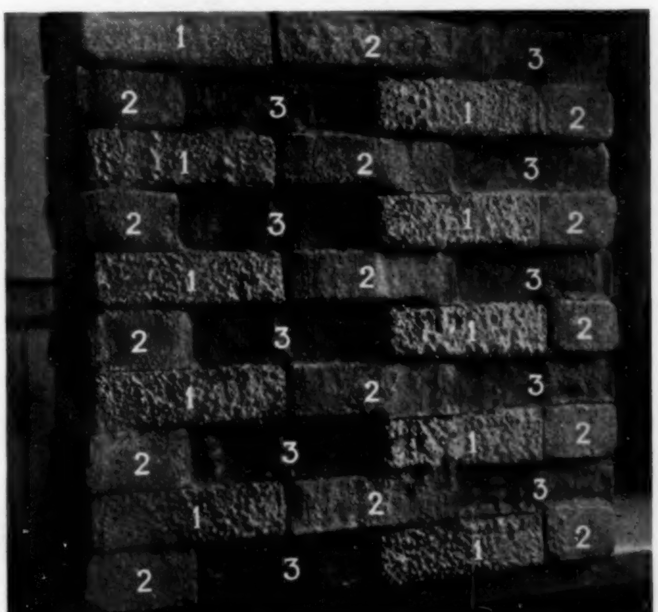
1. Actual furnace conditions, as met with in practice, must be reproduced.
2. Tests must be rapid and not too expensive or elaborate.
3. Cost of test apparatus must be reasonable.
4. Refractories tested should be subjected to the action of molten coal ash slag (or some other flux) as in a boiler furnace.
5. The temperature of the molten slag must be as high as that found in actual practice.
6. Test results must be reproducible.
7. The apparatus should be designed to allow cooling of one side of the test specimens while the hot face is subjected to the action of the molten slag.

While most of the investigators generally recognize the importance of the first six points mentioned above, they have not, in general, considered the importance of an apparatus which will operate with one face of the test specimens cooled, a condition which today constitutes a vital and most important method of protecting boiler furnace refractories against the destructive action of molten coal ash slag.

In the research laboratories of the Carborundum Company, Niagara Falls, N. Y., an apparatus for testing refractories against the action of molten slag has been built, and so far it has been found to fulfill most of the above-stated requirements.

*For a review of the literature see, for example, R. F. Ferguson, *J. Amer. Ceram. Soc.*, **11**, 1928, pg. 90.

Silicon Carbide, Aluminum Oxide and Fireclay Refractories Were Tested Together



The furnace used is built of fireclay bricks and has approximate dimensions of 12 ft. in length, 5 ft. in width, and 6 ft. in height. About 7 ft. from the burner end the furnace is provided with a removable panel which holds the refractories to be tested. For test specimens, 4½x9x2½-in. standard bricks are placed in the center of the panel, and it has been the practice to test 30 bricks at one time.

Heat is supplied by two burners, one an oil burner and the other a powdered-coal burner, placed, for convenience, with the oil burner directly below the powdered-coal burner. The coal burner is supplied with powdered coal from a small hopper by means of a screw feeder. The rate of delivery is adjustable over a range of 25 to 100 lb. per hour. The powdered coal supplies the coal ash required for the test and the oil burner makes it possible to maintain a high and uniform temperature.

Differential Erosion Is Clearly Shown

The powdered-coal equipment was supplied by the Grindle Fuel Equipment Company and is stock equipment with the exception that it was found necessary to substitute for the original rectangular burner a burner made up of 3-in. standard pipe provided with a pair of deflecting vanec, in order to increase the turbulence of the flame. The oil burner was supplied by Tate Jones Inc., and requires about 6 gal. of oil per hour.

Specimens to be tested are loaded into the removable panel and placed in position in the furnace. Openings between the panel and the furnace walls are then sealed. The oil burner is lighted, care being taken that the powdered-coal fan is running with full air supply but with the coal supply shut off. This is done in order to prevent the powdered-coal burner from burning out.

After 24 hours, when the test panel has reached a temperature of about 1,350 deg. C., the powdered-coal feeder is started, and with careful adjustment of air and oil supply and with a coal feed of 40 lb. per hour, a temperature of 1,450 deg. C. is rapidly built up at the face of the panel; and this is maintained throughout the remainder of the test, using optical pyrometer measurements for control. (If desired, temperatures as high as 1,550 deg. C. can be reached and maintained by regulating the burners properly.) For 48 hours combined oil and powdered-coal firing is employed, with the coal supply maintained constant and the oil controlled to make any temperature adjustments. After that the coal

What refractory will best meet that difficult furnace problem? The author describes a small-scale comparative test, suitable for coal ash or other fluxes

supply is cut off and the temperature is held by the oil burner alone for 12 hours in order to remove excess slag which might have accumulated on the test bricks. The oil burner is then shut off and the furnace allowed to cool, the panel is removed and the specimens examined.

It has been found that a high-grade fireclay brick will erode about 1 in. during a 48-hour test. Silicon carbide bricks are eroded little or none, while silica bricks are cut back about $\frac{3}{4}$ in.

The illustrations show clearly the result of a typical test. In this case the test panel was made up of three different types of standard boiler refractories, a "Carbofrax" silicon carbide brick, an "Aloxite" aluminum oxide brick (Carborundum Company's trade-marked products), and a standard fireclay brick. The bricks were placed in the panel so that each type of brick would be subjected to the same conditions independent of the more or less severe local action of the molten slag on the test panel. The three brands were worked in side by side over the whole area of the test panel. The coal used in this particular test and the resulting ash showed analysis as given in the tabulation.

The resistance of each brick to erosion is estimated by measuring the amount eroded and by the depth of penetration of the slag. Standard bricks are carried in each test panel for comparison and control purposes.

As can be seen, the iron content of the coal ash in this test was quite high. This was caused by the addition of pyrite to the original coal, in order to produce a coal

Coal	Per Cent	Ash	Per Cent
Moist.	1.22	Al_2O_3	17.86
V.C.M.	29.95	Fe_2O_3	31.02
F.C.	52.08	SiO_2	50.00
Ash	16.75	CaO	2.90
S	4.28	Na_2O	0.45
		K_2O	1.25

ash with a fairly low melting point. The addition of pyrite, of course, also increased the sulphur content of the coal. It is evident that by selecting a certain coal and one or more suitable fluxes or stiffeners, a slag of almost any desired property or composition can be obtained. The addition of pyrite to the coal in the test described was made in order to accelerate the test so that results could be obtained in a reasonable time.

It is believed that the apparatus can also be used to study the action of any desired molten slag or other material on refractories, without extensive alterations, as the material in question can be blown into the furnace in a manner similar to that in which the coal is now introduced and the temperature can be maintained at any desired value by proper regulation of the oil burner.

So far, no tests have been conducted with one face of the refractory bricks cooled, but a special test panel has been designed and built for this purpose. The test bricks will be cooled by means of a water box placed in the removable panel and behind the test bricks. Provisions will be made to measure the flow of heat as well as the temperature gradient through the bricks.

▼ ▼ ▼

Specific Heat Charts for Gases

Based on new data, charts have been prepared for ready determination of mean specific heats of gases at high temperatures

By A. C. HALFERDAHL
Ottawa, Canada

CALCULATIONS of mean specific heats of gases may be simplified and shortened by the use of the accompanying graphs. The data on which the graphs are based have been taken from Eastman's recent revision (E. D. Eastman, "Specific Heats of Gases at High Temperatures," U. S. Bur. Mines Tech. Paper 445, 1929, 27 pages). They are summarized as follows:

Molal Heat Capacities of Gases at Constant Pressure

	Temp. Range, Deg. Kelvin	Limit of Average Error, Per Cent
Hydrogen		
$C_p = 6.85 + 0.00028T + 0.00000022T^2$	300-2,500	1.5
Nitrogen, Oxygen, Carbon Monoxide		
$C_p = 6.76 + 0.000606T + 0.00000013T^2$	300-2,500	1.5
Carbon Dioxide and Sulphur Dioxide		
$C_p = 7.70 + 0.0053T - 0.00000083T^2$	300-2,500	2.5
Water Vapor		
$C_p = 8.22 + 0.00015T + 0.00000134T^2$	300-2,500	1.5
Hydrogen Sulphide		
$C_p = 7.20 + 0.0036T$	300- 600	5–10
Ammonia		
$C_p = 6.70 + 0.0063T$	300- 800	1.5
Methane		
$C_p = 5.90 + 0.0096T$	150- 400	5.0
Chlorine, Sulphur Vapor (S_2)		
$C_p = 8.58 + 0.0003T$	300-2,500	5.0

In these equations, T is the absolute temperature on the centigrade scale (Deg. Kelvin).

The calculations for developing the graph for water vapor will be given; the same method has been used for the other gases.

From the table specific heat per unit weight on the centigrade scale in place of the absolute scale is:

$$\text{Sp.ht.} = 0.46399 + 0.00004885t + 0.0000000744t^2$$

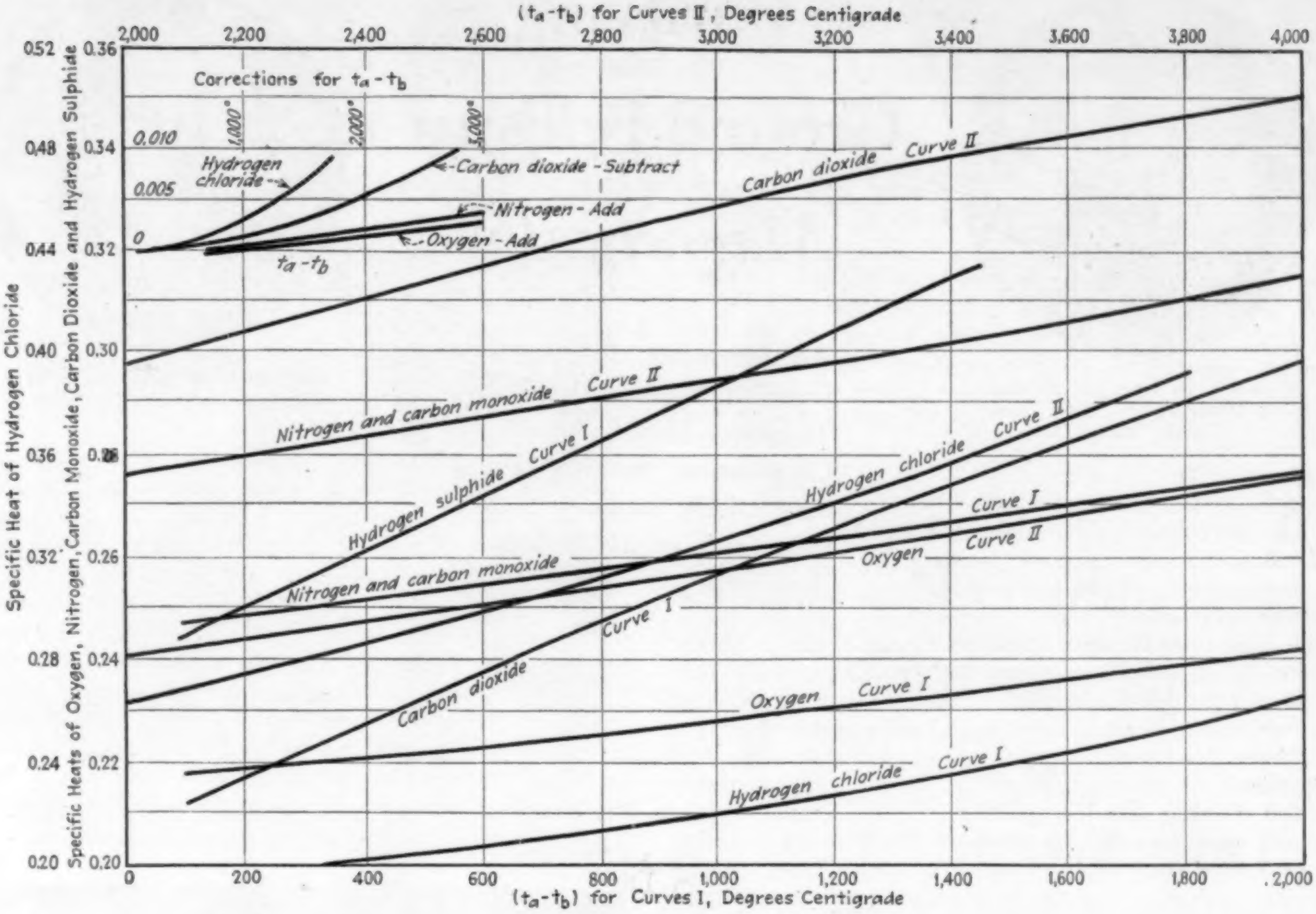
Then the integrated equation for mean specific heat per unit weight between t_b, a lower temperature, and t_a, an upper temperature is:

$$\begin{aligned}\text{Mean sp.ht.} &= 0.4640 + 0.00002443\ (t_a + t_b) \\ &\quad + 0.0000000248\ (t_a^2 + t_a t_b + t_b^2) \\ &= 0.4640 + 0.00002443\ (t_a + t_b) \\ &\quad + 0.0000000248\ (t_a + t_b)^2 \\ &\quad - 0.0000000248 t_a t_b\end{aligned}$$

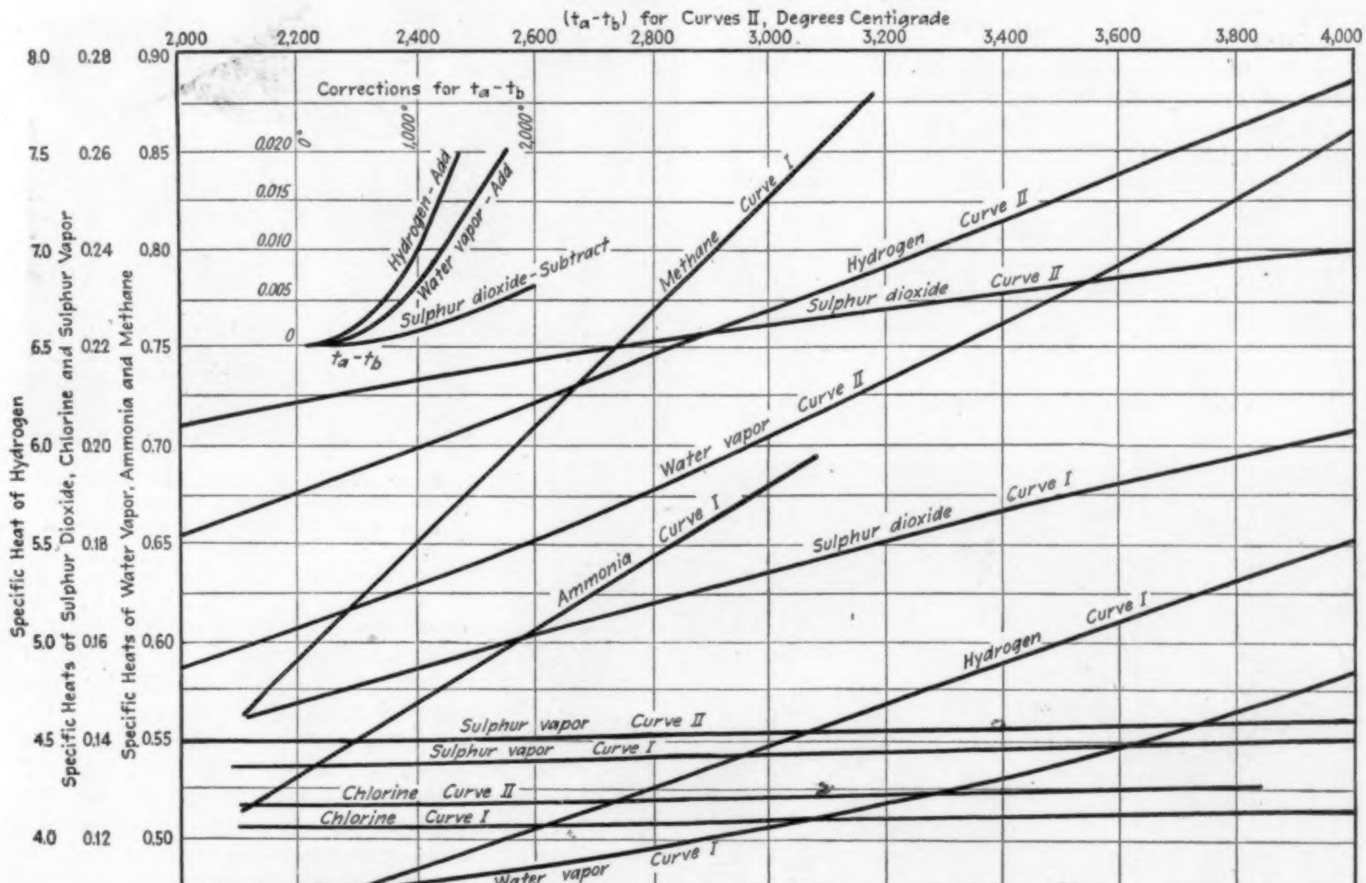
$$\text{But } t_a t_b = \frac{(t_a + t_b)^2}{4} - \frac{(t_a - t_b)^2}{4}$$

$$\begin{aligned}\text{Hence, mean sp.ht.} &= 0.4640 + 0.00002443\ (t_a + t_b) \\ &\quad + 0.0000000186\ (t_a + t_b)^2 \\ &\quad + 0.0000000062\ (t_a - t_b)^2\end{aligned}$$

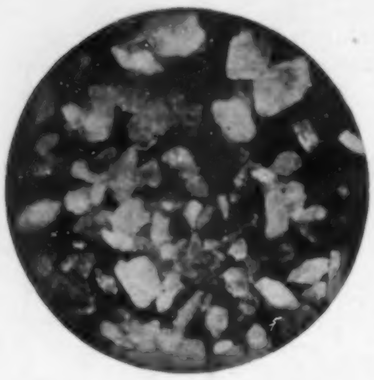
It will be observed that two plots are required for this equation, one for $t_a + t_b$ and one for $t_a - t_b$. The latter usually is a very small quantity and in many calculations may be omitted. It is shown on the graphs and designated as a correction for $t_a - t_b$. The correction for $t_a - t_b$ has the sign of T^2 term in the original equation. All that is necessary to obtain the mean specific heat between any two temperatures is to add and subtract the temperatures and read the appropriate values on the ordinates. The value read for $t_a - t_b$ will be added or subtracted, as indicated, to the value read for $t_a + t_b$ in order to obtain the mean specific heat. For example, the mean specific heat of water vapor between 800 and 1,700 deg. C. is $0.642 + 0.005 = 0.647$.



$(t_a - t_b)$ for Curves II, Degrees Centigrade
Corrections for $t_a - t_b$
Hydrogen chloride
Carbon dioxide - Subtract
Nitrogen - Add
Oxygen - Add
$t_a - t_b$
Carbon dioxide Curve II
Nitrogen and carbon monoxide Curve II
Hydrogen sulphide Curve I
Hydrogen chloride Curve II
Curve I
Nitrogen and carbon monoxide
Oxygen Curve II
Carbon dioxide Curve I
Oxygen Curve I
Hydrogen chloride Curve I
Specific Heat of Hydrogen Chloride
Specific Heats of Oxygen, Nitrogen, Carbon Monoxide, Carbon Dioxide and Hydrogen Sulphide
$(t_a - t_b)$ for Curves I, Degrees Centigrade

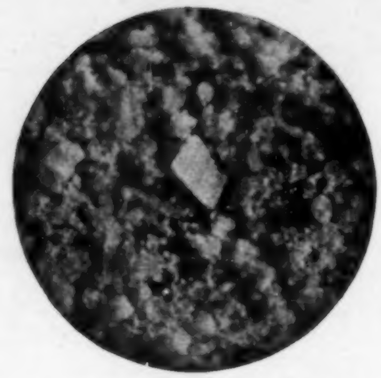


$(t_a - t_b)$ for Curves II, Degrees Centigrade
Corrections for $t_a - t_b$
Hydrogen - Add
Water vapor - Add
Sulphur dioxide - Subtract
$t_a - t_b$
Methane Curve I
Hydrogen Curve II
Sulphur dioxide Curve II
Water vapor Curve II
Ammonia Curve I
Sulphur dioxide Curve I
Hydrogen Curve I
Sulphur vapor Curve II
Sulphur vapor Curve I
Chlorine Curve II
Chlorine Curve I
Water vapor Curve I
Specific Heat of Hydrogen
Specific Heats of Sulphur Dioxide, Chlorine and Sulphur Vapor
Specific Heats of Water Vapor, Ammonia and Methane
$(t_a - t_b)$ for Curves I, Degrees Centigrade



Granular Feldspar of 20-Mesh Size Produced by New Magnetic Process

Purifying Ground Feldspar *Magnetically*



Gradation of Sizes of 20-Mesh Feldspar Is Shown in Ordinary Product

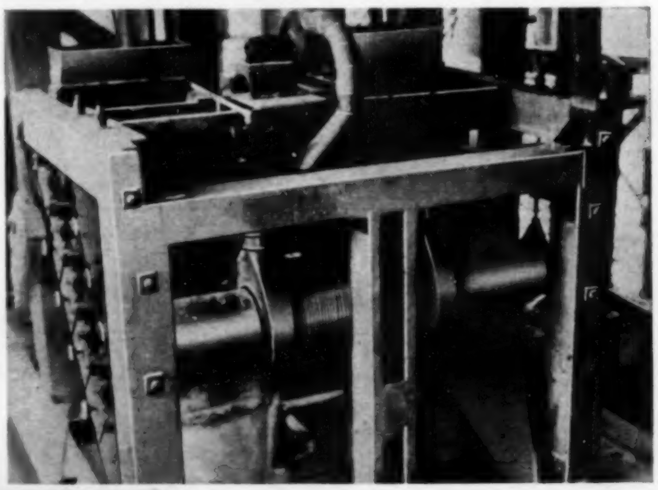
An ingenious dia-magnetic separator developed for the Tennessee Mineral Products Corporation removes even very faintly magnetic materials from ground feldspar

ADAPTATION of a recently developed electro-magnetic induction separator to the processing of ground feldspar has lately been made in the plant of the Tennessee Mineral Products Corporation, at Spruce Pine, N. C., to obtain a granular product specially suitable for the glass industry. This new process has been in operation for about two months and produces a ground feldspar having the same maximum particle size as is standard in the manufacture of glass. But practically all of the dust and fine particles are also eliminated. The result is a free-flowing product which the glassmaker has desired since feldspar was first used in this industry.

The induction separator which is used almost completely removes from the raw feldspar all contaminating materials. Metallic iron, garnet, pyrite, tourmaline, hematite, biotite, and even muscovite are taken from grades of material that are equal to the best the glassmaker has received in the part. The net result is an almost chemically pure feldspar in a form best suited for blending with the sand, quartz, and other raw materials of the glass industry.

Accompanying photomicrographs show the comparison between this new 20-mesh granular material and ground feldspar produced in the usual manner. While the new process gives a material that is practically dustless, previous methods of grinding have resulted in a high percentage of the product passing a 200-mesh screen.

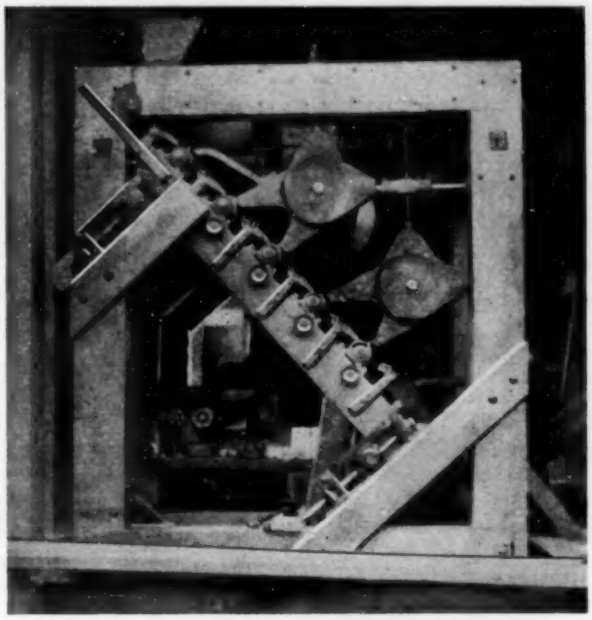
In the new process, crushing rolls are used instead of the pebble mills which feldspar grinders have employed to the exclusion of all other types of reducing equipment. The feldspar is first broken to about $\frac{1}{2}$-in. maximum size in a jaw crusher before it is fed to the first set of rolls. The output of this set of rolls is elevated to a double-deck screen, the lower deck of which produces a product of the required maximum size. The oversize on the top deck is returned to the first set of rolls. The ground material between the two decks of the screen goes to a second set of rolls. This process is repeated through two more sets of rolls, except that on the last set the top-deck screen scalps off mica, and the material between the two decks is returned to the last set of rolls. All rolls are 14x20-in. Sturtevant full-balanced type. Double-deck 4x5-ft. Tyler Hummer screens also are used straight through the line.



Front View of Induction Separator Showing Concentrate Chutes at Bottom, Feed Hoppers and Coil-Cooling Equipment at Top

Plant of Tennessee Mineral Products Corporation From the Air

Ground feldspar, as it comes from the final rolls, will all pass through the required maximum-size screen. It contains a minimum percentage of fine particles, since the screens remove the product from the circuit as soon as it is reduced to 20 mesh. No raw material may be granulated, however, without the production of some fine particles. To remove these the output of the rolls is elevated to a Gayco centrifugal separator. The fines from this separator are delivered to a separate storage bin and blended with similar products for other industries that are produced by fine grinding units in the plant. The oversize from the separator is elevated to screens which classify it in two sizes to facilitate feeding to the induction separator.



End View of Induction Separator Showing Five Rotors, Corresponding Magnet Poles, and Rotor Drive; Drive Is Through a Variable-Speed Transmission

Two 50-ton bins take the surge between the rolls and the induction separator units. The separator has two large coils, the upper one having three and the lower two arms or polepieces on each end. A laminated rotor 30 in. long revolves under each of these polepieces, making five on each side, or ten in all. Special feeding devices consisting of sloping pans between the rotors deliver a thin uniform stream of the ground material over the length of each rotor. As the material passes from one rotor to the next the magnetized particles are pulled out of the stream by the rotor and fall into a tailings receptacle. The gradually cleaned feldspar thus continues on through five successive magnetic separations. At each stage a portion of the contaminating materials is removed. Minerals more highly susceptible to magnetism come out at the upper rotors and those feebly magnetic at the lower rotors.

Belt conveyors and elevators take the output of the magnetic separator to intermediate storage or mixing bins. Various grades of raw material are handled through each roll-separator unit, stored in the mixing bins and then blended to consumers' specifications. An automatic sampling device between the last roll and the storage bin secures frequent samples. These are used in the same process of chemical control which the company has employed for years in governing all of its other products, as previously described in *Chem. & Met.* (35, 1928, p. 562). With this control any blend desired may readily be obtained with close accuracy.

After the granular product has been blended it is put over check screens to catch any oversize which might in any way get into the product prior to shipment. From this check screen the product goes directly to the cars.

The unit producing the Granular Glasspar, as the new product is called, went into operation on Sept. 15, 1930. In its free-flowing, granular nature and low iron content the commercial product has been an improvement over the results that were obtained in long-time laboratory tests on which the construction of the first roll-separator unit was based.

▼ ▼

Simplified Determination of Line Pressure Drop

Pipe-line calculations for fluids are more easily made with an alignment chart designed by the authors

By T. H. CHILTON AND R. P. GENEREAUX

Chemical Department Experiment Station
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Wilmington, Del.

CALCULATIONS of pressure drop in pipe lines carrying any fluid may be made by means of the Fanning equation with the aid of data on the friction factor involved in the equation. Friction factor data have been collected by Wilson, McAdams, and Seltzer, (Wilson, McAdams, and Seltzer, "Flow of Fluids Through Commercial Pipe Lines," *Ind. Eng. Chem.* 14, 1922, pp. 105-19) and a convenient plot is given in Walker, Lewis, and McAdams' textbook, "Principles of Chemical Engineering," McGraw-Hill Book Company, New York, 1927, p. 87.)

Many engineers would prefer, however, to use familiar tables or charts calculated for water flow and convert the results so obtained to the pressure drop for the fluid under consideration. A means of effecting this conversion is given on the chart shown on the following page.

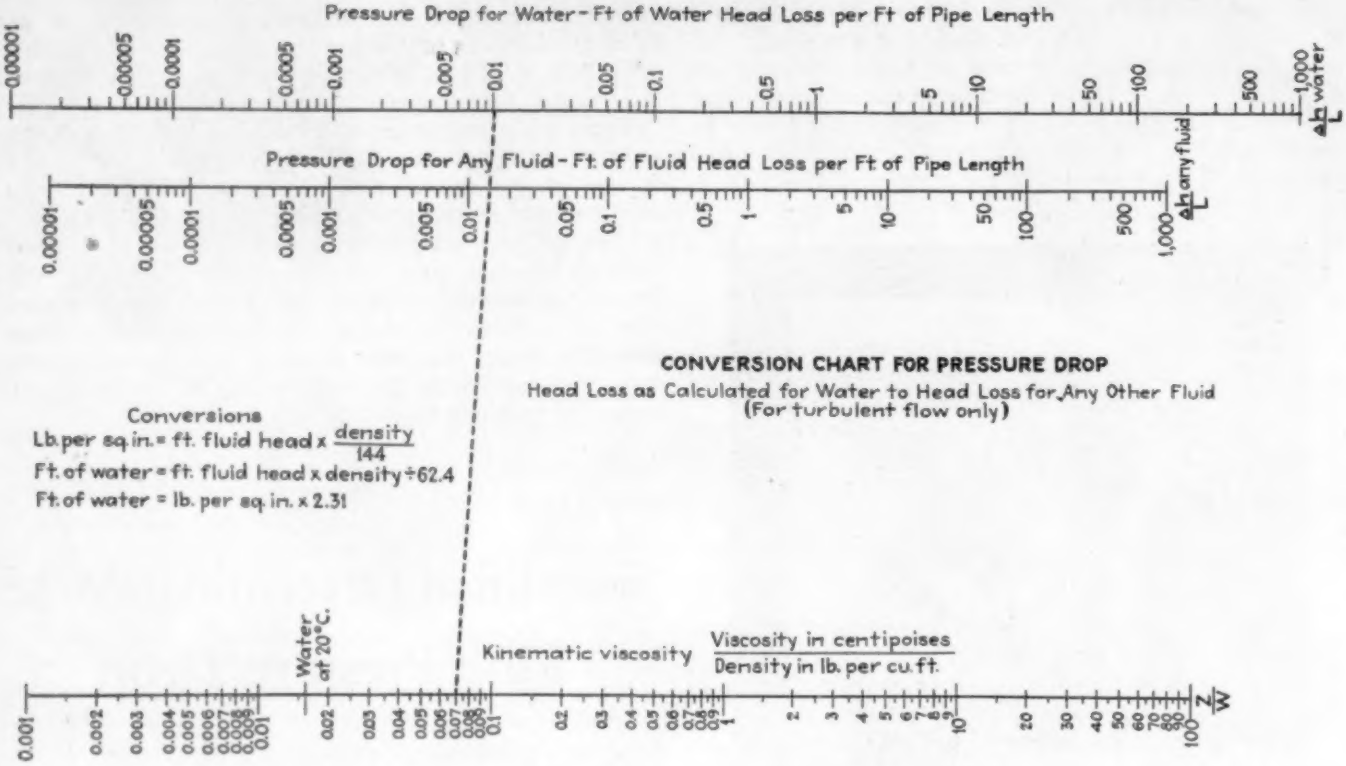
The Fanning equation may be stated as follows:

$$\Delta P = \frac{2fL\rho u^2}{gd}$$

where ΔP = pressure drop in pounds per square foot
f = friction factor
L = length of pipe in feet
ρ = density of fluid in pounds per cubic foot
g = acceleration of gravity, 32.2 ft. per second
d = diameter of pipe in feet.
u = velocity in feet per second.

This expression may be converted to head loss in feet of the fluid flowing, Δh, by dividing by the density:

Contribution No. 45 from the Experiment Station of E. I. duPont de Nemours & Company.



$$\Delta h = \frac{2fLu^2}{gd}$$

Head loss therefore depends on the length, diameter, velocity, and the friction factor. The friction factor is a function of the group known as the Reynolds number, $du\rho/z$, where z = viscosity of the fluid in centipoises. (The relationship of this expression to that given in the references cited, Dus/z, is obvious from their definitions of the units used.)

Now if the length, diameter, and velocity are taken as constant, it is evident that the head loss varies only with the expression ρ/z, or inversely, with z/ρ, which is known as the kinematic viscosity; i.e., the viscosity divided by the density.

It will be evident from the chart how this factor may be introduced to convert the head loss as calculated for water at a given velocity or cubic displacement, to the head loss for any other fluid, at the same velocity, through a pipe line of the same length and diameter. The relation expressed by the chart was derived by assuming a constant average slope of the friction factor curve in the turbulent region and substituting this value for f in the Fanning equation. The chart therefore is useful only for turbulent flow.

Use of the chart may be illustrated by an example. It is desired to know the pressure drop when aniline at 20 deg. C. flows through a 3-in. pipe 100 ft. long at a rate of 500 lb. per minute. The specific gravity of aniline at 20 deg. C. is 1.022, making the density 63.9 lb. per cubic foot; and the viscosity is 4.5 centipoises. The discharge is 0.129 cu.ft. per second. The head loss for water flowing through a 3-in. pipe at this rate is found, by consulting a chart for smooth iron pipe, to be 0.01 ft. per foot length of pipe. Aligning this value on the water head-loss line with 0.07 on the kinematic viscosity line (equal to 4.5/63.9), we read 0.015 on the "head loss for any fluid" line. The head loss therefore is 1.5 ft. of aniline or, using the conversion factors given, 0.66 lb. per square inch.

Data on water flow are given in Williams and Hazen's "Hydraulic Tables" (Wiley, New York, 1920), or in a condensed form in "Cameron Hydraulic Data" (Ingersoll Rand Company, New York, 1930). A convenient chart based on the Williams and Hazen formula has been published by the Equitable Meter Company ("Flow Chart for Water in Pipes," *Water Works Journal*, 22, 1930, p. 8). Various other tables and charts have been made, and the reader may use any with which he is familiar. It is only necessary to make the calculation for the identical velocity as in the problem being considered, and to correct for the kinematic viscosity of the fluid in the method stated.

▼ ▼

Recording Dust Content of Gases

IN A PAPER read before the American Iron and Steel Institute at New York on October 24, 1930, A. W. Simon, of the Tennessee Coal, Iron and Railroad Company, described a recording meter for concentration of dust in blast-furnace or other gases.

The author first derives mathematically a theoretical expression relating the length of a column of dust-laden gas, the dust concentration and the absorption of light traversing the column. Letting L_0 equal the original light intensity, L the intensity of transmitted light, m the dust concentration, x the length of the column, and k a constant, the derived expression becomes Log $(L_0/L) = kmx$ which is confirmed by experiment.

Apparatus for dust determination includes a source of light (concentrated-filament incandescent lamp) placed on one side of a duct, and a light-sensitive device such as a thermopile, placed on the other. This is connected to a recording millivoltmeter. The glass windows in the duct through which the light beam is projected may be kept clean by a modified wind-shield wiper. Condensing lenses should be used to provide a parallel beam through the duct and concentrate light on the thermopile.

Chrome Iron Indispensable In Nitric-Acid Plant

By E. ST. P. BELLINGER

Development Engineer
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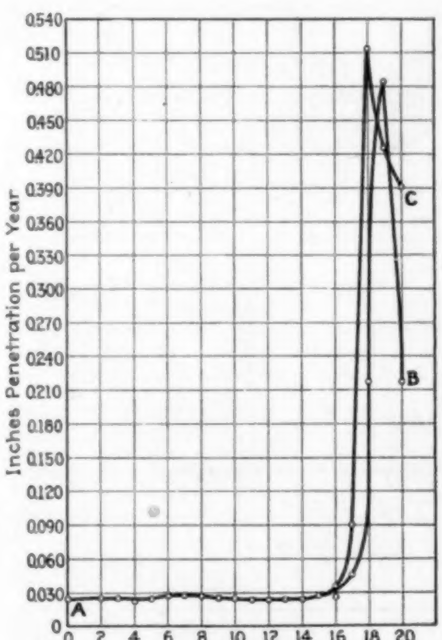
Parlin, N. J.

CHROME STEELS have been known to the makers and users of alloy steels since 1872. As early as 1895, Dr. Essen, of the Krupp works in Germany, applied for patents on chrome steel having a chromium content as high as 12 per cent. The remarkable resistance this alloy shows toward numerous corrosive agents also has been known for many years. The major development of this important alloy has taken place almost entirely during the past ten years. Earlier attempts in making chrome steels were confined to alloys containing from 1 to 8 per cent chromium. In chrome steels where the carbon content is extremely low—under 0.12 per cent—the alloy exhibits the properties of an iron or mild steel.

This article is concerned mainly with the so-called "18" chrome iron, containing low percentages of carbon, the development of which has contributed greatly to the advancement in modern methods of nitric-acid manufacture. Chrome iron has many uses in the ammonia-oxidation plants producing 55 to 65 per cent nitric acid. From the standpoint of efficiency and economy it cannot be substituted by other alloys. The alloy is used for castings, piping, tanks, absorption towers, and the like.

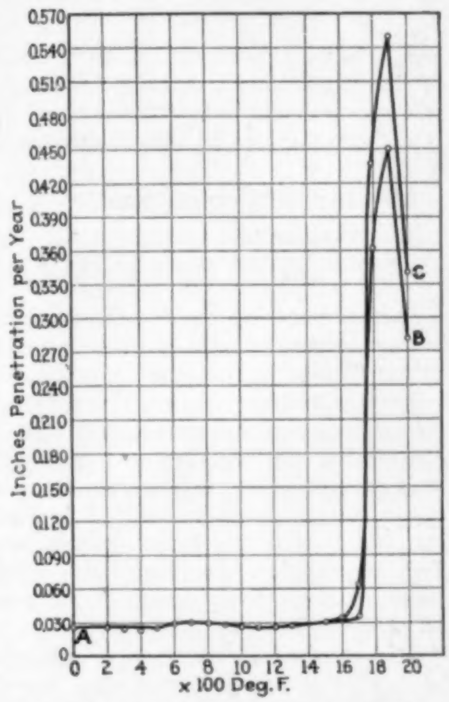
The addition of chromium to a low-carbon steel increases the resistance to corrosion by nitric acid. The addition of chromium from 1 to 8 per cent shows no appreciable resistance to corrosion. The increase in resistance is slight, and gradual up to 12 to 13 per cent, but between 13 per cent and 18 per cent the resistance increases rapidly. Beyond 18 per cent additional chromium will affect the anti-corrosion properties only slightly, and the advantages to be gained are offset by the cost of production. Carbon contents above 0.12 per cent lessen the corrosion-resistant properties of the alloy. Although I have made no corrosion tests on this metal containing high silicon, except in the form of castings, I am of the opinion that the addition of silicon above 1 per cent reduces its resistance to corrosion. In lesser quantities silicon is essential.



Corrosion of Chrome Iron in Boiling 65 Per Cent Nitric-Acid Vapor

Curve *AB*, corrosion during first 48 hours' boiling; Curve *AC*, corrosion during second 48-hour period, sample from an annealed plate with following percentage composition: Cr, 17.4; Ni, 0.17; Si, 0.20; S, 0.019; P, 0.016; Mn, 0.41; C, 0.10. Samples air-cooled at temperatures indicated.

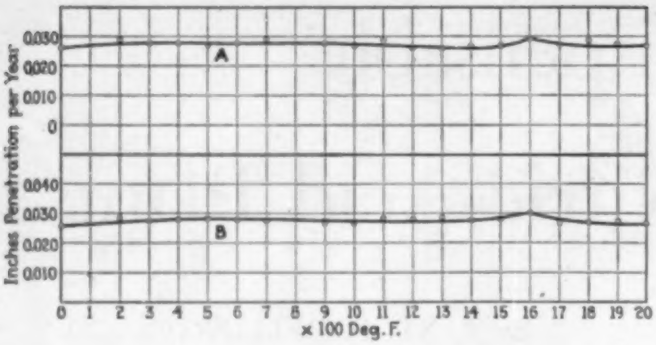
The data in the following table will give the reader an idea of the corrosion resistance of chrome iron in nitric acid. It must not be thought that an alloy having the analysis shown will always have the corresponding anti-corrosion properties, since the heat-treatment of the metal is an important factor in determining the rate of corrosion. In all of the data given, the same procedure and care were taken in preparing the samples and making the tests. The heat-treatment—prolonged annealing at 1,430 deg. to 1,470 deg. F.—given the material from which the samples were cut was essentially the same. Corrosion tests were made in 65 per cent c.p. boiling nitric acid, using reflux condensers. The ratio of the liquid to exposed area of test piece was 200 cc. per square



Corrosion of Chrome Iron in Boiling Nitric Acid, Sample Used and Conditions Being the Same as Shown in the Preceding Graph

No. of Tests* Plate & Tube Material	Average Analysis Cr/Si.	C.	Mn.	P.	S.	Si.	Ni.	Cr.	Max. Variation in Corrosion.	Corrosion, In. Pen. per Yr.
2	43	0.24	0.40	0.015	0.018	0.10	0.19	4.27	0.30	12.09
2	55	2.13	0.41	0.012	0.012	0.31	0.14	16.95	0.15	0.205
6	47	0.093	0.40	0.014	0.020	0.39	0.20	18.34	0.005	0.0175
9	51	0.084	0.40	0.014	0.020	0.35	0.16	17.90	0.002	0.0204
18	55	0.095	0.39	0.016	0.021	0.32	0.20	17.70	0.003	0.0245
26	60	0.10	0.40	0.018	0.021	0.29	0.21	17.30	0.008	0.0310
9	71	0.105	0.38	0.021	0.016	0.24	0.20	17.10	0.005	0.0400
8	79	0.098	0.38	0.014	0.018	0.21	0.17	16.52	0.011	0.0510
Castings										
4	28	0.20	....	.....	.....	0.60	....	16.93	0.05	0.062
6	12	0.18	....	.....	.....	1.64	....	19.08	0.03	0.140

*Number of tests made from samples having different analyses.



Curve A, Corrosion of Chrome Iron in Boiling 65 Per Cent Nitric-Acid Vapor; Curve B, Corrosion of Chrome Iron in Boiling 65 Per Cent Nitric Acid; Samples Air-Cooled at Indicated Temperatures and Subsequently Annealed From 1,450 Deg. F.

inch. Samples were boiled 48 hours, removed, cleaned, dried, weighed, then replaced for another 48 hours. The rate of corrosion is calculated as inches penetration per year from the loss in weight during the second 48-hour boil.

Inches penetration per year =

$$\frac{533.8 \times \text{loss in weight of sample in grams}}{\text{Specific gravity} \times \text{No. hours boiling} \times \text{area in sq. in.}}$$

It is interesting to note the marked tendency toward higher corrosion rates with decrease in chromium and silicon except in the case of castings where the silicon content is relatively high. The corrosion rates shown by the castings are comparable with those of plate material, considering the analyses and porosity of the products. It is reasonable to suppose that the rate of corrosion on cast material generally will be higher than on worked material having the same analysis and heat treatment. This supposition has been found to be true, although some instances have shown the cast material to be just as good as plates or tubes.

One of the principal factors in producing chrome iron having good corrosion-resisting properties is the final heat-treatment. Many users of chrome iron have had parts of an installation fail during operation, although the product before fabrication in many instances had excellent physical and corrosion-resisting properties. Some of these failures are due to lack of information and also to the non-observance of instructions by the workmen responsible for the production and installation of the equipment. Prolonged annealing at 1,450 deg. F. is generally considered the best heat-treatment. The time required varies with the bulk of metal charged to the furnace. It is necessary only to insure slow heating, thorough soaking at 1,450 deg. F., and slow cooling.

Unlike straight carbon steels, chrome iron is very sluggish in changing its structure, because of the low thermal conductivity of the material, which is four to five times lower than carbon steel. It has been found that the metal becomes hard and brittle, accompanied by increased corrosion when exposed to temperature from 600 deg. to 800 deg. F., for long periods or to temperatures above 1,700 deg. F. followed by air-cooling. The effect of numerous heat treatments on chrome iron is best shown by the accompanying graphs prepared from experimental data.

Eighty samples of chrome iron were cut from an annealed plate having the analysis shown and an initial corrosion rate of 0.0257 in. penetration per year. The test pieces were placed in a cold muffle furnace and the temperature raised 40 deg. F. per hour. Beginning at 200 deg. F., four pieces were removed and air-cooled and with each increase of 100 deg. F., four more samples were removed and air-cooled. Two samples of each set were replaced and annealed from 1,450 deg. F. after soaking four hours.

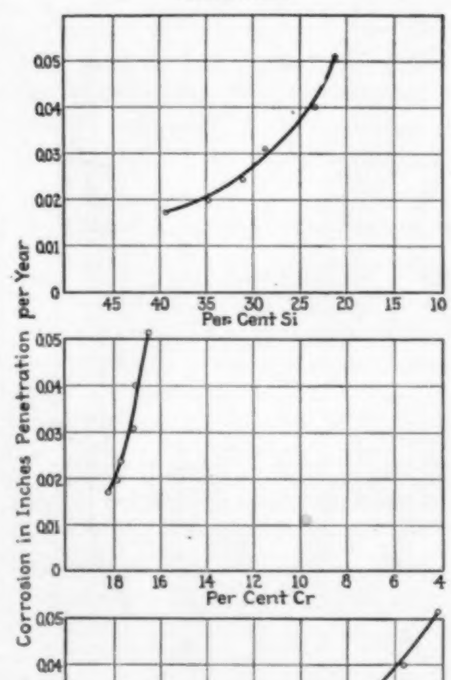
It is evident from the data that heating and air-cooling at temperatures above 1,700 deg. F. destroy the corrosion resistance of the material; re-annealing restores the original qualities. A slight rise is shown in the corrosion rates when the material is heated between 600 deg. and 900 deg. F. and air-cooled. It is my opinion that the corrosion will be more pronounced the longer the metal is held between 600 and 900 deg. F. before air-cooling.

The corrosion has been determined on samples of annealed plate and tubes subjected to heat, shock, and strain. The material, when properly annealed and worked in fabrication, will stand more abuse than is generally supposed. Corrosion rates on samples of $\frac{3}{8}$ in. plate bent cold through 170 deg., hot through 170 deg., at 1,400 deg. F. and air-cooled, and hammered cold through 120 deg. with a 20-lb. sledge show no appreciable increase over the original value. The material can be safely worked at temperatures from 1,000 deg. to 1,400 deg. F.

The quality of tubes is dependent largely on the composition of the material and the heat-treatment given the finished product. It has been shown that hot finished tubes when annealed are the equal of the cold-drawn product in both physical and chemical qualities.

Numerous authorities have discussed the passive state of chrome iron. It is generally believed that such a state is produced by pickling. I am not prepared to say whether or not this is the case. There has been no evidence of such a condition of the material when exposed to nitric acid. A clean, smooth surface is essential in preventing excessive corrosion, and it makes no difference whether this is accomplished by pickling or mechanical means. The pickling process as practiced by various producers of chrome iron is primarily for the removal of dirt, scale, and any other impurities on the surface which prevent a bright finish. Imperfections such as seams, splits, or slag inclusions are readily detected on a pickled surface.

Corrosion of Chrome Iron of Numerous Percentages of Chromium and Silicon in Nitric Acid



Regulating Organic Reaction Under High Pressure

By P. H. GROGGINS and R. HELLBACH

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Washington, D. C.

IN THE early days of the American dyestuffs industry there was a lack of exact operating procedure and an absence of mechanical refinements for the production of uniform products of standardized purity. It was not long, however, before several of the responsible leaders realized that variations in operating control were economically disastrous.

Appreciation of the value of highly standardized conditions did not filter into the operating ranks with contagious rapidity. It required patient missionary work to educate chemical operators to the necessity of avoiding fluctuations; one executive even asked his men to visualize a world at 0 deg. C. and one at 1 deg. C. While it is true that ordinary chemical operations are not subjected to a phenomenal change by a variation of 1 deg. C., it is a fact that divergences from the optimum conditions often exercise a deleterious effect.

Within recent years, however, progressive organizations have been alert to provide mechanical devices to insure safe operations and standardized control. In this respect it appears that they are now generally in advance of the research laboratories. There are, of course, certain mitigating factors for this situation, such as insufficient funds. It appears, however, that research laboratories could well afford to further emulate commercial operations, so that the results of preliminary research might be translated more readily into large-scale operations.

This paper describes the high-pressure apparatus which has been used at this laboratory for carrying out experiments in the ammonolysis of halogeno anthraquinones. The present equipment is a modification of the apparatus described by Phillips (*Ind. Eng. Chem.* 17, 721, 1925). Experience has suggested and necessity has made imperative certain changes and additions.

The original construction is shown in Fig. 1. It consisted of a sheet-iron tank, *A*, which was surrounded by heat-insulating material, *C*, and the whole contained in wooden case *B*. Tank *A* was filled to the proper level with heavy cylinder oil, which was heated by electric heating coil *D* and kept in circulation by stirrer *H*. It was also provided with two auxiliary electric heating coils, *E*, which were used only to bring the bath rapidly up to the required temperature. The temperature of the bath was controlled by thermostat *F* operating a relay (not shown) which controlled the current passing through coil *D*. The temperature was indicated by a thermometer inserted in well *G*. The reaction was carried out in two specially constructed steel bombs, *I*, consisting essentially of a steel chamber provided with a top, nut, and lead gasket. With this arrangement there was no difficulty in keeping the reaction chambers gastight. The steel bombs were held in place in carrier *J* by clamp *K* and screw *L*, and were rotated endwise by means of a train of gears driven by electric motor *S*. The carrier was raised and lowered by racks *M*, and pinions *N*, operated through crank *O*. It was held in position when either raised or lowered by means of ratchet gear and stop *P*. The carrier revolved in bearings *Q*, and moved on guides *R*. The stirrer *H* was operated by motor *S* through gears *V*, *W*, and *T*.

With continued use at 200 deg. C. or over, a coating of carbon was deposited on the submerged electric heating coils of the original equipment. This caused a gradual leakage in the coils which diminished their heating efficiency and charged the entire apparatus. Certain series of experiments further demanded that the reaction times continue over periods when personal attendance was not feasible. Safety devices were therefore required to avoid overheating in case the relay which actuated the thermostat failed to perform properly. It was deemed advisable also to control automatically the time of heating so as to provide a continuous reaction period of definite duration. Finally, it was considered necessary to provide visible and permanent records of each experiment.

In order to accomplish these aims it was necessary to modify the assembly of the original equipment and to change the electrical heating and control apparatus. The oil bath was suspended from a steel framework

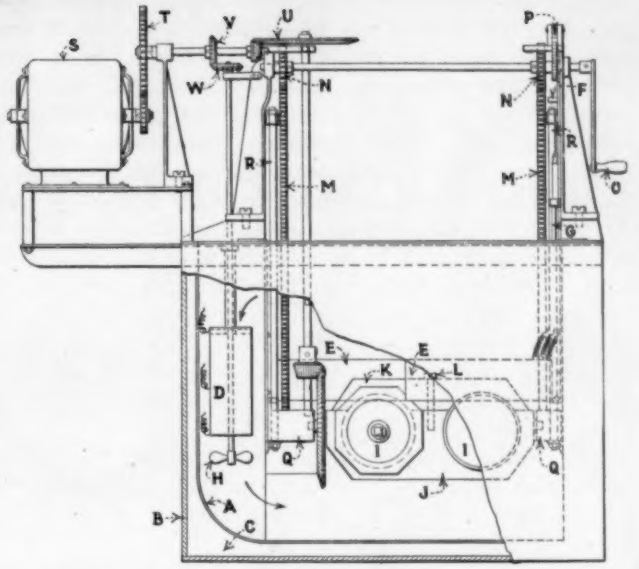
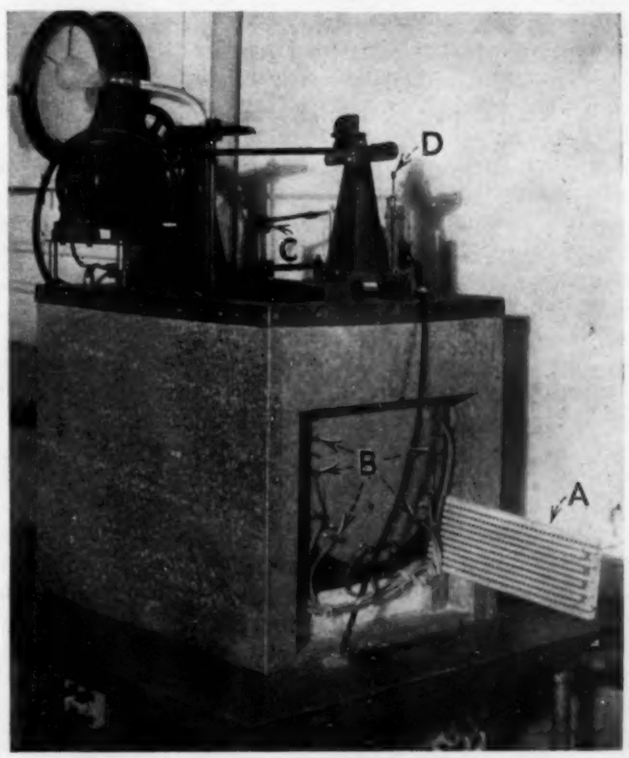


Fig. 1—Original High-Pressure Apparatus (See Text)

Fig. 2—Modified Apparatus (Lifting Mechanism Removed)



which also carries the mechanical superstructure. Surrounding the base of the oil bath is a sheet-metal hood containing four partitions. In the five grooves thus provided are placed the base and the front and back refractories (Fig. 2, *A*) containing the coiled Nichrome resistance wires. The terminals from these coils are attached to the binding posts located on the transite board (Fig. 2, *B*) covering one end of the oil bath. This board is attached to and suspended from a piece of angle iron and is completely insulated from the bath. The lead wires are then brought back to the switches. The current supply to the switch panel must first pass through the fusible alloy (Fig. 2, *C*), which breaks the circuit at 250 deg. C. It will be observed that the entire outside case of the oil bath is free of fuses or switches.

The heating is accomplished by arranging the refractories and connecting the coils in such a manner that a three-heat control is provided, thereby avoiding the use of any external resistances.

By a suitable combination of auxiliary heating elements it becomes necessary to use the submerged coil *D*, Fig. 1, to reach the desired temperature. The temperature is then regulated by means of a mercury thermostat *D*, Fig. 2, which operates a 100-ohm relay in the circuit of a 6-volt storage battery. This relay in turn actuates a standard contact device for controlling the current to the submerged heating unit in the pump well. In operation, the thermostat controls the temperature of the oil bath to within $\pm$ 1 deg. C. of the desired point. The heating units and motors are designed for 110 volts. A maximum of less than 1 kw. per hour is required to operate the entire apparatus at 180 to 200 deg. C.

IN carrying out the amination, the oil in the bath is first warmed by the outside auxiliary elements to approximately 100 deg. C. by using the low heat on the coil surrounding the oil pump *H*, Fig. 1. When the oil is quite fluid, the pump is started and the temperature raised to the desired point, which is then automatically controlled by the thermostat. The sealed autoclaves are then fastened to the carrier *J*, Fig. 1, by the clamp *K*, and lowered into the oil. The electric time switch is set to turn off the current at a specific hour. When this occurs an electric contact is made to start the small motor which operates the mechanism for raising the autoclaves out of the oil.

The elevation of the pressure bombs is accomplished by means of a worm wheel attached to the shaft, which normally raises the autoclaves. The worm wheel is driven by a worm and reducing gears operated by a small motor. Since the motor is automatically started by the same time switch which controls all the current to the apparatus, the bombs are removed from the oil bath at the termination of the heating period. As soon as the bombs are elevated to the proper height a trip breaks the electric circuit and stops the motor.

Two types of autoclave covers are used for the bombs. The simpler construction contains a needle valve and permits only of releasing the internal pressure after the charges have been cooled. The other type is used when the charge is blown hot immediately after removal from the oil bath. This head is provided with a standpipe and a threaded side-coupling in addition to the needle valve which seals the bomb. The side coupling is used for making screw connections leading to the container which receives the charge. During the heating period the coupling is sealed with a small screw to keep out the oil. At the termination of the run the autoclaves are removed and placed in a rack, which holds them firmly. By opening the needle valve the charge is blown under its own pressure into the receiving vessel. This procedure is desirable when soluble byproducts are formed during the amination. By blowing the charge into a comparatively large volume of a specific solvent it is possible to remove a large proportion of the impurity. For example in the preparation of 2-aminoanthraquinone, from 2-chloroanthraquinone, a mixture of dilute alkali and nitrobenzene may be used to remove the soluble hydroxy compounds that are formed.

The apparatus described has been found to function with utmost safety and satisfaction. It has made possible continuous operation over long periods with a minimum of personal or mechanical attention. By its use dependable data relating to the high-pressure ammonolysis of halogen compounds have been obtained.

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Plating Nickel on Aluminum

IN A PAPER recently presented to the French Académie des Sciences, M. Ballay described a method of plating polished aluminum, all previous methods requiring surfaces that have been roughened. M. Ballay devoted his attention to coating nickel, since it is possible then to deposit further coatings of copper, cadmium, silver, gold, and so on. Most chemical solutions put forward for the purpose of preparing aluminum for nickel plating are very acid and contain small quantities of a metal which is more noble than aluminum, such as iron, manganese, or nickel, which may become deposited by displacement on the aluminum. M. Ballay has, however, turned his attention to a solution the corrosive action of which will be of a minimum character, while any displacing action will be that of leaving a metallic paste on the aluminum.

Tests have demonstrated that this can be secured by the use of very hot solutions (90 to 100 deg. C.) of ferric chloride and hydrochloric acid. Temperature plays a very important part in the action of the solution. When cold it has a yellow color, but it becomes red when heated, and only then does the deposit of iron from solution take place. Over 50 differently proportioned solutions of ferric chloride and hydrochloric acid at temperatures ranging from normal up to boiling point have been tested with pure and commercial aluminum, the alloys Alpax, Almasilium, and Duralumin; an alloy of 92 aluminum and 8 copper, and one of 85 aluminum and 15 zinc. The results of the tests show that with solutions of from 1.7 to 43 gr. of ferric chloride in 0 to 1.7 molar solutions of hydrochloric acid a pasty iron deposit on aluminum surfaces can be secured which will take a closely adherent deposit of nickel. While the solution must be varied slightly in accordance with the particular alloy, the one which has proved to have the widest sphere of use consists of 22 gr. of ferric chloride and in 0.1 to 0.7 molar hydrochloric acid. Any type of hot nickel-plating bath may be used for plating on the aluminum prepared in the manner described.

Safe Handling of Unfired Pressure Equipment

By M. E. BONYUN

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A FULL and comprehensive treatment of this subject might well begin with a discussion of design. Since this is an important topic in itself, the paper will be limited chiefly to the question of safe handling. However, it is desirable to post a few warning signs concerning design, for this must be of interest to all safety engineers, particularly to those who may be responsible for the care of pressure apparatus.

1. Beware of homemade pressure vessels. They are usually unauthorized designs. Their margin of safety is usually narrow, and their relation to pressure lines not well defined.

2. Single-riveted lap-joint construction of longitudinal seams should always be avoided for pressure service. The simplest form of riveted tank construction for pressure should be double riveted on the horizontal seam, with single riveted circumferential or vertical seams, since a cylindrical tank is twice as strong transversely as it is longitudinally.

3. The welded lap joint is a poor type of construction, and more especially so if the lap is welded only on one side. The safest and most efficient type of welded tank is that with V-shaped butt joints—a double-V on the longitudinal seams and a single-V on the transverse seams.

4. If tanks are built with concave heads, welded or riveted, with the pressure on the convex side, the thickness of the heads should be one and a half to two times that of the shell.

DESIGN of pressure vessels has been greatly improved in recent years, not so much to meet new conditions of use as to bring about greater safety. There still are in service, and will be for many years, however, numbers of the older and lighter vessels, and it is with these that safety engineers must be principally concerned. It is quite possible that in any plant several years old there are many containers varying greatly in strength, which are nevertheless called upon for the same type of service. Again, tanks of equal strength will be differently used, as with materials of varying degrees of corrosiveness. This diversity complicates the problem of maintaining all these vessels within safe limits of working pressure. To accomplish this, organized periodical inspections are necessary.

Assuming that one was called upon to make an inspection and report on the entire unfired pressure vessel installation of a large plant which had been in service for ten or more years, the first step would be to familiarize oneself with the extent of the work and to prepare an inventory of every individual piece within the scope of the investigation. The inventory should include certain questions of design; namely, dimensions of containers, material and thickness of the shell, size and pitch of rivets, type and efficiency of seams, manhole size and shape, number and size of bolts, and diameter of bolt circle. Having recorded its maximum working pressure along with the identification of any tank, one is now able with these facts to determine the maximum working pressure for which the tank was designed.

Next, ascertain accurately the operating conditions of the vessel, such as its length of service, the degree of corrosiveness of the material stored, and whether or not the contents may expand under atmospheric temperature.

TANKS must now be entered individually, if possible, together with a first-class boiler maker, and an internal visual inspection made as follows:

1. Hammer test all the rivets; loosening of rivets is the early indication of declining strength.

2. Examine the interior caulking at all seams and especially at the scarfing. Interior caulking of seams is a necessity in all pressure tanks, no matter what the contents may be. In the case of acid storage the rivets should also be caulked on the inside. The rivet is not intended to stop leaks; interior caulking is for that purpose and if well done, prevents the liquid contents from reaching the rivet holes.

3. The inner walls should now be carefully examined for corrosive action. Ordinarily if the loss of metal has not been severe, its extent can be readily ascertained by a steel straight edge and shims. If, however, the corrosion has been serious enough to cause suspicion of distinct weakness, then at selected points on both sides of the vessel the walls should be drilled, say three or four places on each side, with a $\frac{1}{8}$ to $\frac{3}{16}$ in. drill, and the thickness of the plate at each hole determined by a depth gage.

4. It is always a good rule to follow that any pressure vessel should be better by 50 per cent than its maximum working pressure. Stress calculations should not be relied on solely to determine this 50 per cent margin of strength. Safe practice requires that it be finally established hydrostatically.

5. From year to year when these interior visual and hammer test inspections are made, one's judgment and experiences will direct whether or not such inspections should be followed by a hydrostatic test of one and a half times working pressure. At least once in five years, however, every pressure vessel should be tested hydrostatically as a matter of principle. If a pressure container is known to be operating under corrosive conditions, examination should be made as often as twice a year.

For vessels in which pressure is not generated, but the pressure derived from an outside source, a safety valve or valves may be installed on the system or on the re-

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Condensed from the author's paper, "Safe Handling of Unfired Pressure Vessels and Equipment," presented on Oct. 2, 1930, before the Chemical Section of the National Safety Council at Pittsburgh.

ceivers distributing such pressure. It may not be necessary to install a safety valve on each individual pressure container on the system, but the relief on the common pipe lines or on the receivers should be all-sufficient to provide the necessary protection. The valve or valves should have enough discharge capacity to prevent the pressure from exceeding the maximum working conditions by more than 10 per cent. The discharge pipe should always be the full size of the outlet of the valve, free from all bends if possible; and if there are bends they should be sweeping pipe bends and not elbows. Elbows usually result in sharp right angles which are an obstruction to the escape of excess pressure. When there must be bends, the pipe should be securely anchored and the escape should be to the atmosphere. Between the valve and the piece it protects, as also in the discharge line, there must not be any hand-operated valve.

FOR VESSELS in which pressure may be generated, independent of any outside source, a safety valve must be connected directly to the vessel. When safety valves are used, those of the spring-loaded type should have preference; and where a safety valve is exposed to freezing temperature, a drain pipe should be installed at the lowest point to relieve water that might collect. However, the spring loaded safety valve is unsuccessful where liquid and solid matter, or of course a mixture of both, is to be discharged. The action that militates against a spring loaded valve, in discharging any pressure associated with solid matter, is of course, that the material may work under the seat, and seepage due to the draft produced will eventually allow the inlet pipe to become clogged without the knowledge of the operator, whose faith is pinned to a safety device which does not exist.

Especially does the writer's experience serve him in the use of safety valves on high pressures, say beyond 1,000 lb. It is well to say here that the safety engineer is today being called on to secure safe operation against pressures that run into thousands of pounds. It is a commonplace experience that no valve of the bevel-seat, spring-loaded type, once it has discharged such a pressure, will again perfectly reseat. It is 100-to-1 shot that it must in every case, after discharging, be removed, replaced by another one, and have its seat reground. Even for relieving pure gases—that is gases free from moisture or solid matter—at those high pressures, its seat is liable to be cut and leakage will prevail after discharging. The spring loaded safety valve, as a safety device, is not keeping pace with the rapid demand for higher pressures, nor is its material of construction running parallel with the corrosive effects in the ever-expanding chemical industry. It is being made stronger certainly, to withstand higher pressures, but its design and method of operation show little or no improvement.

It is because the safety valve has not given assurance as a protective device for high-pressure vessels in the chemical industry that responsible engineers are recommending the frangible safety disk, and it is being used successfully for pressures up to 5,000 lb. The disk, with the advice of the chemists, is fashioned of material best calculated to resist the corrosive effects of the atmosphere in which it is situated.

Besides the base metals, disks are being made of electrolytic copper, pure silver, gold and tantalum. We believe platinum might be employed as material for rupture disks. Possibly 90 per cent of the material of a disk of the bulging type and 100 per cent of those of the shearing type can be salvaged after rupture; and the precious metals have a resale value very near their original price.

There are in service two types of frangible disks. They are popularly known as the bulging type and the shearing type.

The first of these begins with a flat insert and the metal bulges under increasing pressure until it gives way at the crest of the bulge. This is the correct way for the disk to rupture. In order to accomplish this, a receptacle must be so designed, first, to hold the insert firmly so that it cannot slip in the process of bulging; second, a chamber above the disk must provide space for the free bulging movement; and third, the circular edge of the chamber at the bottom must be slightly rounded to prevent the whole crown of the bulge from giving way.

The failure of any one of these provisions will destroy the rating of the disk.

In the first instance, if the insert should slip in its receptacle, more metal will be pulled into the breaking area than was contemplated in the original insert. This will raise the rupture point. In the second instance, if the disk should strike any part of the chamber before rupturing, the area exposed to pressure will be lessened and again the breaking point will be raised, if the disk breaks at all. In the third case, if the edge of the bulging chamber is left sharp, the disk will break out as a whole at the periphery, which according to the experience of the writer lowers the calculated rupture point. Again, with a sharp edge there is danger of the whole crown going forward into the discharge pipe and stopping the rush of escaping gas.

HOWEVER, if care be exercised in the design of the disk receptacle as above outlined, and if the disk material be pure, accurately rolled and annealed, and chosen to suit the chemical conditions of the operation, one has a protective device whose rupture point in pounds per square inch for any given thickness will follow a definite law which is a function of the exposed area; i.e., a breaking point which can be computed. It is good practice, however, in frangible disk protection, to select three inserts cut adjacently for each renewal, to break the two outside pieces in the shop machine and to use the middle piece on the vessel. This gives the inspector a chance to check the computed table, and also to eliminate possible faulty material.

In the shearing disk, the disk material is held gas tight between two heavy washers by a bolt through the center. The disk extends beyond the washer about an inch. The disk and washers, together with a strip of tough, pliable metal, are suspended across the throat of the relief opening and held in place by a shearing ring bolted to a steel flange which is welded to the inlet pipe at the throat. The shearing ring and bottom washer together constitute the shearing edges. They should preferably be made of tool steel. This unit is enclosed in a housing which provides ample space for movement of the disk in shearing.

In operation, when the internal pressure reaches the ultimate shearing stress, the whole disk shears except where the tongue of heavier metal protrudes. This now acts as a hinge, first holding the slug of washer from going forward and at the same time turning it out of the path of the rushing gas. The rupture point of the shearing disk is about 80 per cent of that of the bulging type, thickness of disk material and exposed area being equal. Photographs of both of these frangible disks and their housings are given in the National Safety Council's Safe Practice Pamphlet No. 68.

Chemical Engineer's Bookshelf

Chemistry in Coal Processing

Coal Carbonisation. By *R. Wigginton*. Charles C. Thomas, Springfield, Ill.; 1930. 287 pages. Price, $6.50.

Reviewed by G. L. Montgomery

INTEREST in coal carbonization is of three kinds: First, there is the plant operating force and designing engineers, who wish to know how carbonizing equipment is designed and operated. This might be called the mechanical engineering interest. Then there is the group which is chiefly interested in carbonization as a heating process and whose interest might be described as of a power engineering nature. Finally, there are those whose interest is chiefly concerned with the chemical changes that occur during coal carbonization and the working up of the byproducts and who may be grouped as chemical engineers and chemists.

The first and second of these groups already have at their disposal a copious literature, modern enough in character to be really useful. The third group, however, has few useful texts available, at least in the English language. This fact makes Mr. Wigginton's work particularly timely.

After two short chapters, 49 pages all told, devoted to the early history and subsequent development of coal carbonization equipment, there are five extensive chapters dealing primarily with the chemistry of the operations carried out in the coal-processing industry. The action of heat on coal, coal gas, ammonia and its recovery, coal tar, and the formation and properties of coke are the subjects treated.

The work is not exhaustive, but it is complete enough to promise distinct utility to the chemist who is connected with a carbonization plant or desires to make such connection. Nowhere has the present writer seen the chemical side of the industry treated with as great clarity, within such short compass.

British Industry and Methods

The United Kingdoms: An Industrial, Commercial, and Financial Handbook. By *Hugh Butler*, American Trade Commissioner in London, and officials of the Departments of Commerce and State. Bureau of Foreign and Domestic Commerce, Washington, D. C. 953 pages. Price, $1.75.

Reviewed by Arthur W. Allen

A KNOWLEDGE of facts is the best basis for an understanding of the tangibles and intangibles that comprise the national life and commercial activities of any nation. In regard to the United Kingdom, many such facts are obscured by normal prejudices, or are unobtainable. Essential information is known to comparatively few persons, being scattered in a vast number of publications.

Despite the advantage of a common tongue, American industry as a whole has labored under the disadvantage involved by a lack of understanding of British commercial methods, a condition remedied by the issuance of the volume under review. Its 38 chapters are replete with information and statistics on industry and commerce in the British Isles. In readable form is given a picture of conditions under which each commodity is produced, supplemented by data on a host of related subjects, such as overseas trade and transportation facilities, a complete survey of British financial and insurance methods, and classified information on inter-empire and international commerce.

The text is accompanied by maps, charts, tables, and illustrations. A comprehensive bibliography and index complete one of the most useful publications issued to date by the Bureau of Foreign and Domestic Commerce.

Color Lexicography

A Dictionary of Color. By *A. Maerz* and *M. Rea Paul*. McGraw-Hill Book Company, New York, 1930. 207 pages, including 56 color plates. Price, $12.

Reviewed by Richard Koch

EMBRACING with its usual relentless gusto so subtle and delicate a friend as Color, the public—and its dependent industries—quite inevitably overreached its faculties as an appreciative host and soon had its recently installed hero in an ailing, bewildered, and grossly overfed condition—the well-known effects of immoderate hospitality. Fortunately, the victim still possesses his former excellent capabilities; and perhaps his present vogue has only aggravated a chronic disorder to the point of an enforced remedy. This present volume represents such a cure, dispensed just when it began to be high time.

Not that color has been a particularly neglected department of science, for apart from such inspired work as that of Newton, Goethe, and Ostwald, many other fruitful agencies and individuals have devoted themselves to entirely commercial phases. But in this new volume, the authors have exploited a very unusual combination of effective typography, exemplary color reproduction, and, above all, discriminating judgment, to achieve as compact, durable, and authoritative a compendium as any industrial reference library could wish to possess. And the industries, in addition to the dye and pigment firms, that have been saddled with the color fad are now so numerous that this recommendation is really a broad one.

A necessary "catechism" introduces the true heart of the book, the color plates, and these are followed by a brief history of color standardization and an exhaustive name index. Of the color dictionary itself, it is possible to speak only with the heartiest approval. Graded according to generic groups, the 6,000 and odd hues are presented on indexed plates and are also characterized by a name, if a sane or traditional one happens to exist. The ink maker and printer certainly share in the glory too: the pigments are light-fast, a good degree of "whiteness" has been attained, and the difficult matter has come flawlessly from the presses.

In their editorial capacity, the authors have painstakingly avoided any scientific departure, in either nomenclature or classification; the goal of the book, they rightly assert, is immediate practicability. This decision, however necessary, also justifies the regret that some methodical scientific system, such as that of Ostwald, could not have benefited from the sponsorship of such an authoritative reference work. It is time that color had its own c.g.s. system. On the other hand, the authors have fortunately taken a stand against the innumerable foolish fancies with which fashion confounds color description. Their remarks are waspishly recommended to the Textile Color Card Association, which includes in its 1931 spring colors such enlightening names as Amulet Blue, Chukker Green, and Putty Beige.

Impurities and Metallic Properties

IMPURITIES IN METALS. By *Colin J. Smithells*. Second Edition. John Wiley & Sons, Inc., New York, 1930. 190 pages. Price, $5.

Reviewed by GILBERT E. DOAN

AN ELEMENTARY treatise on metallography, this book is written from the standpoint of the technologist rather than of the scientist, but the text is scientifically sound. It develops the basic ideas about pure metals and about their X-ray examination. It presents the laws of equilibrium and the resultant structure in binary alloys, and then proceeds to study representative binary systems. These systems, however, are not those of common alloys but of alloys of a pure metal and a common "impurity." It is at this point that the book diverges from the orthodox text. It deals also with ternary alloys in which one component is an "impurity," and discusses "modifying," age hardening, and segregation in this same manner. Non-metallic impurities and gaseous impurities are dealt with in the same way. The text is beautifully illustrated. Finally, there are chapters on the chemical and physical properties of metals as these properties are affected by the presence of impurities. The book represents an intelligent and basically sound approach to a study which is everywhere receiving increasing attention: that of minor constituents or "impurities" in metals.

Corrosion of Structural Materials

SCHUTZ DER BAUWERKE GEGEN CHEMISCHE UND PHYSIKALISCHE ANGRIFFE. Edited by *Otto Graf* and *Hermann Goebel*. Wilhelm Ernst und Sohn, Berlin, 1930. 224 pages. Price, 22 M.

WITHOUT much fuss about defining a chemical engineer, mechanical engineer, or chemist, the authors recognize the necessity of a work such as this for all technologists who are concerned with corrosive attacks on their structures. Therefore the text of the present work offers not so much the summaries of corrosion tests and results as a general survey of the various structures used in practice and the attacks that have been found to occur under different conditions. It happens that the greater part of the book is taken up with such materials as concrete, cement, stoneware, natural stone, and refractories; metals receive shorter consideration and wood only a dozen pages or so. But in each case the treatment proceeds from the rational starting point of existing structural practice, and leads up to the available means for correcting difficulties.

The work is urgently commended to the attention of engineering firms engaged in industrial construction and even more so to the departments in chemical firms that are responsible for their own new construction. The photographic illustrations are not only plentiful but uniformly excellent as well.

Recently Arrived

CHEMICAL SYNONYMS AND TRADE NAMES. By *William Gardner*. Third Edition. The Industrial Book Company, Inc., 280 Broadway, New York, 1930. 355 pages.—A standard work, with emphasis on commercial and trade aspects, brought up to date, now containing some 20,000 references.

PETROLEUM FACTS AND FIGURES. Public Relations Department, American Petroleum Institute, New York, 1930. 232 pages.—The third of this useful compilation of statistic material carries an appendix on conservation, research, and code of practices.

BIBLIOGRAPHY OF ORGANIC SULFUR COMPOUNDS (1871-1929). By *B. Borgstrom, R. W. Bost*, and *D. F. Brown*. American Petroleum Institute, New York, 1930. 187 pages. —A concise summary of information on sulphur chemistry related to the petroleum industry, carefully culled from abstract sources and checked back to the references. The items are divided according to chemical groups.

A. S. T. M. TENTATIVE STANDARDS, 1930. American Society for Testing Materials, Philadelphia, 1930. 864 pages. Price, $8, cloth.—The 155 tentative standards included in this year's edition practically all deal with chemical engineering materials and are therefore of extraordinary interest.

ANNUAL TABLES OF CONSTANTS AND NUMERICAL DATA, Index to Vols. I to V. Union of Pure and Applied Chemistry. McGraw-Hill Book Company, Inc., New York, 1930. 382 pages.—The main sections of this index include references to names and a very extensive one according to formulae.

INDEX TO IRON AND STEEL PATENTS. By *V. Everett Kinsey* and *Thomas E. Hopkins*. American Compilation Company, Pittsburgh, Pa. 356 pages. Price, $25.—Any attempt to cover the field of invention relating to iron and steel is, of course, an enormous project and it is impossible without going over the same field to judge how completely it has been covered here. But there is no indication that the work has not been done most thoroughly, and accessory lists have been included to facilitate reference.

THE CONSTITUTION OF STEEL AND CAST IRON. By *Frank C. Sisco*. American Society for Steel Treating, Cleveland, Ohio, 1930. 332 pages. Price, $3.—The need on the part of many outside of the steel industry for a discussion of the theory underlying the constitution of ferrous metals caused the preparation of a series of educational articles for the society, which are now combined in this volume.

TRANSACTIONS, INSTITUTION OF CHEMICAL ENGINEERS, Vol. 7, 1929. Published by the Institution, London, 1930. 218 pages. Price, 1 guinea.—Complete report of activities in 1929, together with papers on fuels, metals, vapor recovery and evaporation.

Selections from Recent Literature

Heterogeneous Catalysis. Erwin Sauter. *Zeitschrift für Elektrochemie*, October; pp. 874-82. Attention is called to the value of studies of chemical sorption as a means of obtaining a clear picture of the processes involved in heterogeneous catalysis. The necessary theoretical reasoning is not unduly complicated, and sorption studies provide comparatively simple means of following the intermediate stages through which catalysts pass. The essence of the problem is the same as in other catalytic studies: namely, to ascertain the reaction mechanism and the nature of molecular activations at interfaces where chemical reactions are accelerated. Recent investigations are reported which have to do with the causes of activity of the "active centers" in differentiated catalyst surfaces. These investigations include measurements of the sorption of carbon dioxide and other gases on active charcoal, of hydrogen on surfaces of certain metals, etc. They lead to recognition of heat of activation as an important factor in catalysis; and it is pointed out that there is an apparent as well as an actual heat of activation. The apparent heat of activation includes the heat of desorption of the reaction products, where these have a tendency to retard the reaction. True heat of activation is a result of the influence of temperature on the catalytic activation, decomposition, and reaction processes. In general, chemical sorption methods may be applied to the analytical study of any catalytic reaction at interfaces.

Wood in Plant Equipment. Friedrich Moll. *Korrosion*, Sept.. 25; p. 33. Although wood cannot be welded or riveted like metal, it has certain advantages which keep it much in favor for various kinds of equipment in the process industries. It has high resistance to acids and alkalies, and does not form with them colored compounds to discolor or damage products; it is strong and light, cheap, durable, and easy to work into required shapes. Its thermal and electrical conductivities are very low. Difficulties due to permeability can be avoided by judicious choice of kind of wood according to conditions of use. Thus, oak contains tannin and is not suitable for iron liquors; eucalyptus contains essential oils, teak contains silica, and some other woods contain substances which unfit them for some uses; but the range of choice of woods is so wide that these special cases are not an obstacle to the use of wood vessels. In some instances—e.g., in bleaching—use of wood is almost compulsory, because of the lack of other cheap materials which will withstand the chemicals used. In such a case, the only problem is to choose the right wood; even the most highly resistant metals or alloys are liable to attack when particles of different metals, precipitated on the container walls, set up galvanic couples. Wood is preferred in the fermentation industries because of its low heat conductivity, which facilitates uniform temperature control; for storage of flammable liquids, because it does not throw sparks when struck; and even in metal working, where acid resistance is important—e.g., for pickling vats.

Dust and Fumes. A. Vogt. *Chemische Apparatur*, Sept. 25; pp. 209-10. An improved system is proposed for removal and recovery of dusts and fumes which are so valuable as byproducts, or so noxious that none may be allowed to escape. A container is built—for example, in the form of a sludge settling tank—and is filled with a liquid which is not a solvent for the dust or fume to be collected. The collected solids settle to the bottom of the tank and are pumped off for recovery or disposal. The liquid overflow from the tank (clear liquid) is pumped by another pump to the top of a vacuum condenser, into which is also drawn the dust or fume from its source. From this condenser a vertical pipe, dipping under the liquid surface, conveys the liquid with its fresh charge of solids to near the bottom of the settling tank. A suitably regulated quantity of gas from the dust or fume source is pumped in during this operation. If it is innocuous, it can be allowed to escape from the settling tank into the atmosphere; if not, collecting hoods may be provided under the liquid surface to retain the gas. Calculations are given showing the power consumption and the volumes of gas and liquid to be pumped under a given set of operating conditions.

Refrigeration. R. Plank. *Chemische Fabrik*, Oct. 8; pp. 397-9. The properties of refrigerants are discussed, as related to the requirements of compression, absorption, and adsorption types of refrigeration machines. On the basis of this discussion, some of the leading ways in which refrigeration serves the chemical industries are outlined. These include liquefaction of gases, freezing of liquids, crystallization of certain salts from their brines, separation of liquid and gaseous mixtures into their components, and control of reaction velocities. Liquid chlorine and solid carbon dioxide are important products of refrigeration, chlorine being one of the gases which can be successfully liquefied at atmospheric pressure. The German potash industry uses refrigeration on a very large scale to separate magnesium and sodium sulphates, taking advantage of the much greater solubility of magnesium sulphate in very cold brines. The Edeleanu process in petroleum refining and the purification of illuminating and coke oven gases are among the accepted industrial applications of refrigeration. There are some applications which are less familiar, being rather problems which are not yet fully solved. One of these is to render illuminating gas non-toxic by removing the carbon monoxide. Another, holding promise of great commercial importance, is the method of dewatering peat by freezing. If this can be cheaply accomplished, vast fuel reserves will thereby be made available in North Germany, Russia, and elsewhere. There are also numerous actual or potential applications of refrigeration in connection with rubber, soap, textiles, yeast, tobacco, leather, etc.

Gas and Liquid Flow. J. Versluys. *Proc. Koninklijke Akademie van Wetenschappen*, Amsterdam, 1930; No. 5, pp. 450-6. Periodic flowing is a frequent occurrence when gases and liquids are rising in vertical pipes. This periodicity may be explained by assuming the possible existence of a foam condition and a mist condition. In absence of a stabilizer, the foam condition can exist only when the liquid occupies the greater part of the total volume; the mist condition, only when the gas predominates in volume. A precise boundary at 50 volume-per cent may be assumed for simplicity; it probably is approximately true for distilled water and for oils which do not form stable foams. Where it is not true, the volume range for the two conditions may overlap, or may not meet at all. In the case of overlapping, either condition may occur in certain mixtures. In the foam condition there is a small, and in the mist condition a large, difference in the velocities of the gas and liquid particles. Periodicity is explained on the basis of relations resulting from these facts. With certain amounts of total flow per unit of time, there exist two critical pipe diameters; the foam condition is possible only above the larger, and the mist condition only below the smaller of these. These considerations are applied to a discussion of surging and intermittent flow in gas-and-liquid piping systems, lifting of oil in oil wells being one example.

Solvent Action and Viscosity. P. Stamberger and C. M. Blow, *Kolloid-Zeitschrift*, October; pp. 90-5. It has been found that the origin of the sample and the consistency of its solutions have no influence on the swelling pressure or osmotic pressure in rubber solutions. To make a further test of this observation, measurements were made with solutions of rubber made from carefully purified latex; with commercial "first latex

crepe", unmasticated and masticated; and with "first latex crepe" after mastication in an atmosphere of nitrogen. The first two samples gave gels; the last two merely gave very viscous solutions in rubber solvents; but all four showed the same osmotic pressure. The original observation being thus confirmed, attention is given to the factors which cause changes in viscosity of gels or solutions of lyophilic colloids, independently of their osmotic pressure or swelling pressure. Among the principal factors are mastication, compounding with such pigments as carbon black, aging (in solution or after mastication but before dissolving), and kind of solvent. In these measurements the solvents were benzene and petroleum ether.

NON-FERROUS CORROSION. Bernward Garre. *Korrosion und Metallschutz*, September; pp. 200-1. It is a familiar fact that cold-worked iron dissolves faster in acids than iron which has been worked while hot. With copper and lead, a hard wire dissolves more slowly than a softer, heat-treated wire. It has been reported that tin behaves more like iron, dissolving more rapidly in acids if cold-worked. Confirmatory tests show that this is true of tin slightly contaminated with other metals, but not of very pure tin (99.99 per cent). The comparison was made between the very pure tin and a commercial quality of which the purity was 99.9 per cent. With the cold-worked metals, the curve showing rate of solution as a function of the time of exposure to acid rises steeply in the case of the commercial tin, and falls rapidly in the case of the very pure tin. Curves are shown also for rate of solution in acid as a function of the degree of cold-working. In making the measurements of rate of solution, the surface of the metal was first removed by 12 controlled exposures to concentrated nitric acid, and the test pieces thus prepared were suspended in 10 per cent hydrochloric acid. The weight loss method was used to determine the quantity of metal dissolved.

Recent Government Publications

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated, pamphlet is free and should be ordered from bureau responsible for its issue.

Metal Specifications. U. S. Navy Department specifications, available from the Department as follows: General Specifications for Inspection of Material, Appendix II, Metals: 46S23, chrome-molybdenum steel bars and billets; 47S14a, chrome-molybdenum steel sheet or strip; 44T17 and 44T18, seamless chrome-molybdenum steel tubing; 44T19, aluminum tubing; 46A3a, aluminum bars, rods, and shapes; 47A2a, sheet aluminum; 46B24b, ornamental bronze castings; 46S13a, cold-rolled or cold-drawn machinery steel rods and bars; 46S22, mild carbon steel bars and billets; 47S17a, mild carbon steel quarter-hard sheet or strip; 47S15, annealed spring steel sheet or strip; and 46R1a, nonferrous rod for gas welding.

Miscellaneous Government Specifications. From the Navy Department: 52S6, dope solvent; 52D5, cellulose acetate dope; 52D2, cellulose nitrate dope; 51-I-2, pickling inhibitors; 51C2c, calcium phosphide; and 41T18a, hand torches for welding and cutting. From the Federal Standard Stock Catalogue Board, 5 cents each: O-S-61, nickel salts for electroplating and electrotyping; W-E-441, amorphous carbon electrodes; W-B-131, storage batteries for ignition, lighting, and starting; TT-E-521, black pigmented enamel; TT-C-231 and TT-C-236, green chrome oxide; TT-S-271, orange shellac; and O-F-380, fire extinguishing liquid, carbon-tetrachloride base.

Brazilian Market for Belting, by Rudolf E. Cahn. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 729; 10 cents.

Soda specifications, Federal Standard Stock Catalogue Board. Specifications as follows: O-S-571, soda-ash; P-S-641, laundry soda; O-S-581, granular sodium-carbonate; P-S-631, caustic soda for cleaning purposes; 5 cents each.

Washing, Cleaning, and Polishing Materials. Bureau of Standards Circular 383; 10 cents.

French Chemical Industry and Trade in 1929, by Daniel J. Reagan and Earle C. Taylor. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 726; 10 cents.

Simplification of Sizes and Terminology of High Volatile Bituminous Coal. Bureau of Standards Miscellaneous Publication 113; 5 cents.

Manganese Studies. Three mimeographed reports of investigation from the Bureau of Mines, as follows: R. I. 3033, The Action of Sulphur Dioxide on Manganese Oxides at Elevated Temperatures, by C. W. Davis; R. I. 3045, Concentration Tests on the Manganiferous Iron Ores of the Cuyuna District, Minnesota, by F. D. DeVaney and J. B. Clemmer; and R. I. 3048, Study of High-Manganese Slags in Relation to the Treatment of Low-Grade Manganiferous Ores, by C. H. Herty and others.

The Rate of Decomposition of Polyhalite by Water and by Saturated Sodium Chloride Solutions, by H. H. Storch. Bureau of Mines Report of Investigations 3032.

Notes of the Determination of Molybdenum, by H. A. Doerner. Bureau of Mines Information Circular 6335.

Titanium Reports. Two information circulars from the Bureau of Mines as follows: I. C. 6365, Titanium and I. C. 6386, Deposits of Titanium-Bearing Ores, both documents by E. P. Youngman.

Gypsum in 1930. Mimeographed statistics from the Bureau of Mines for first and second quarters of 1930, giving production, imports and sales. Dated Oct. 4, 1930.

Silica in 1929. Bureau of Mines pamphlet; 5 cents.

Test of Ampoules Filled With Palladium Salt Solution for Detecting Carbon Monoxide, by L. B. Berger and W. P. Yant. Bureau of Mines Report of Investigations 3030.

Acrolein as a Warning Agent for Detecting Leakage of Methyl Chloride From a Multiple Refrigeration System, by H. H. Schrenk, F. A. Patty, and W. P. Yant. Bureau of Mines Report of Investigations 3031.

Method for Measuring Voids in Porous Materials, by J. D. Sullivan and others. Bureau of Mines Report of Investigations 3047.

Extinction of Methane Flames by Dichloro-Difluoro-Methane, by G. W. Jones and G. St. J. Perrott. Bureau of Mines Report of Investigations 3042.

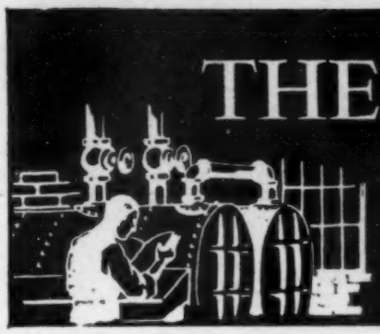
Specific Heat of Water Vapor at High Temperatures Derived From Explosion Experiments, by E. D. Eastman. Bureau of Mines Information Circular 6337.

The Trauzl Block Strength of Dynamites, by N. A. Tolch and G. St. J. Perrott. Bureau of Mines Report of Investigations 3039.

Petroleum Reports: Petroleum Refineries in Foreign Countries, 1930, Bureau of Foreign and Domestic Commerce Trade Information Bulletin 723, 10 cents; International Trade in Petroleum and Its Products, 1929, Bureau of Foreign and Domestic Commerce Trade Promotion Series 99, 30 cents; and Review of Fatalities in the California Petroleum Industry During the Calendar Year 1929, by R. L. Marek, Bureau of Mines Report of Investigations 3041.

Petroleum and Natural Gas Data. Mimeographed documents from the Bureau of Mines as follows: Petroleum, petroleum products, and natural gasoline, 1929; miscellaneous products of petroleum refineries, 1929. Production of Natural Gasoline Exceeds Two Billion Gallons in 1929; Consumption of Natural Gas Increased 22 per cent in 1929; and Survey of Fuel Consumption at Refineries in 1929, by G. R. Hopkins, Report of Investigations 3038.

Production statistics from 1929 Census of Manufactures in preliminary mimeographed form for: Fertilizers; sulphur; druggists' preparations; patent or proprietary medicines and compounds; explosives; soap; silverware; rubber tires and inner tubes; tin and other foils; rayon; tin cans and other tinware; carbon paper and inked ribbons; bluing; and wall plaster, wall board, and floor composition.



THE PLANT NOTEBOOK

Devising a Private Filing System

By George A. Prochazka, Jr.
Du Pont Ammonium Corporation
Wilmington, Del.

A CHEMICAL ENGINEER will find it helpful to develop a reference file in which to store odds and ends of information, clippings from periodicals, and such other data as may have future value. If the important items related to his activities are preserved, the engineer will be in a position quickly to supply information which otherwise might not be available without a tedious search of the literature.

The problem of filing is one of devising a system which is so designed that data can be quickly obtained from the files. The methods of librarians, who seek to classify all human knowledge in a logical manner, are not suited to the informal needs of the chemical engineer. He will do well, therefore, to forget the Dewey Decimal System and all other methods that involve an elaborate numerical code. He cannot afford to spend time on card-indexing or similar cumbersome schemes. His files need be nothing more than folders, labeled to suit his own needs, arranged in alphabetical order so as to be self-indexing.

Knowledge of the principles of classification, as evolved for the science of logic, is a valuable adjunct to the development of private files. In classifications, items are grouped together into minor sections (species), and these are arranged under a major heading (genus). Division is the inverse operation, a major heading being split up into minor parts. The first step in classification or division is to select a guiding principle or point of view (i.e., whether a material is of interest as a catalyst, as raw or finished stock, as construction material, etc.). It is from this point of view that the differences between items are established and the necessary groups are created.

Definitions are needed to set the limits and bounds of the various topics or groups, which must be so selected that there is no overlapping ground between them. Enough minor groups must be established to provide for all items; i.e., the classification must be exhaustive. The point of view from which the classification or division is made must not be altered during the work. A minor topic, however, can always be treated as a major topic and can be further subdivided according to an entirely different point of view. It is to be noted that the restriction on the shift in the guiding principle holds only for the arrangement of species under one genus: in a continued subdivision each species becomes a genus. These principles of logic should be followed as closely as possible in the development of private files.

Practical application of the principles of classification is sometimes rather awkward. The problem is most easily understood by taking up an illustrative case. A file is begun merely by inserting a folder for each topic which is of interest. Soon it is discovered that some topics, being more important than others, accumulate a volume of data which becomes so large as to require subdivision. The single-drawer file consisting of a collection of topics alphabetically arranged might, after a number of years, become an eight-section file with a separate drawer for each of the following topics:

1. Chemical Industry.
2. Corporation Data.
3. General File.
4. Material File.
5. Nitrogen.
6. Processes.
7. Process Machinery.
8. Resources.

Data in each of these drawers need not be subdivided according to the same principles. For instance, "Chemical Industry" could be divided according to the scheme followed in the U. S. Census of Manufactures, in Thorp's Outline of Chemical Industry, in Roger's Manual of Industrial Chemistry, or on a basis of some combination of these classifications that more closely fits the needs of the user. The geographic principles might be employed to subdivide "Nitrogen" or "Resources." The "General File" and the "Material File" might be nothing more than a collection of interesting topics. The exact development of a file classification is governed by the needs of the user.

A code mark or a numerical filing arrangement will rarely be found satisfactory. The alphabetical sequence usually is best. Articles, clippings, memoranda, etc., should be dated and clearly marked as to source of information. When two articles related to different topics are printed on the same piece of paper, one should be photostated. The same expedient will be found convenient when a single article is of interest from several different viewpoints. If photostating is not feasible, a cross-reference slip on a piece of colored paper can be inserted in the least important file. Articles which deal with a wide variety of subjects can be filed under an appropriate general heading. An indexed loose-leaf notebook should be provided for recording unusual decisions, definitions, and obscure points which may be difficult to remember at a future time. A private file should be designed to require a minimum of cross-indexing, reference notes, etc.

The particular folder in which an article was placed depends on the point of view held at the time the article was classified for filing. For instance, in *Chem. & Met.* for December, 1928, there was published: "Hydrogen From Coke-Oven Gas Gives Cheap Ammonia at Ostend." This article could have been filed as "Nitrogen," as "Ammonia," as "Hydrogen," or as "Coke-Oven Gas." Being of major interest as a review of Belgian fixation practice, the clipping was accordingly filed in the geographic nitrogen file under Belgium. The possibility of having several reasons for adding a technical article to the files leads to overlapping in the ground covered by the folders. The viewpoint from which specific data are examined shifts from time to time. Consequently, to be certain that most of the data available in the files have been found, a subject must be examined from all possible angles even though there is a folder which exactly corresponds to the topic under consideration. A carefully compiled reference book is exceedingly helpful in finding data in the private files.

Spheres Versus Cylinders

UP to the present time, cylindrical vessels have comprised the great bulk of pressure vessels, in which the question of shape is so highly important. Recently, however, increased interest has been exhibited in the use of spherical vessels. For comparatively low pressures, for example, 15 lb. pressure, as would be suitable for the storage of volatile liquids handled in petroleum refineries, and for pressures up to 2,000

lb., for the storage and sometimes shipment of compressed gas, a number of possibilities in spherical vessels have been developed.

It is well known that a spherical vessel exposes the minimum surface for a given volume and also involves a minimum weight of material for construction, for a given wall thickness. It is not so well known, however, just how cylinders and spheres compare in weight

Relation of Sphere and Cylinder Weights for Same Service

Ratio Length to Diameter	Relative Weights of Vessels
0 (sphere)	1.000
1	1.200
2	1.250
3	1.275
4	1.286
5	1.294
10	1.312
∞	1.333

when designed for the same service. The accompanying table, furnished by the Chicago Bridge & Iron Works, shows this relation very clearly. Not only cylinders and spheres compared on a weight basis but also a series of cylinders having a widely varying ratio of length to diameter are included. In all cases the cylinders are intended to have hemispherical ends. An interesting conclusion is that the weight of a cylinder can never be greater than $1\frac{1}{3}$ times the weight of a sphere with equal wall thickness and capacity.

Pressure Measurement in Viscous Fluids and Plastic Solids

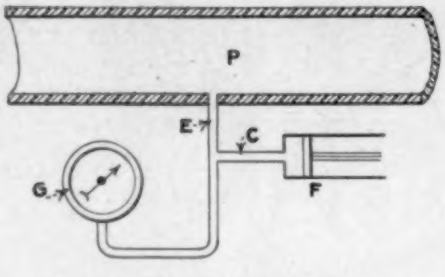
By R. V. Kleinschmidt*

Assistant Manager, Process Division, Du Pont Ammonia Corporation, Charleston, W. Va.

MEASUREMENT of pressures developed in highly viscous fluids or plastic solids, and in particular in fluids which solidify or gel on cooling or on standing, is of interest in a wide variety of industries. A device recently developed in the laboratories of Arthur D. Little, Inc., and used to measure the pressure on soap during extrusion, may be of value in other industries as well.

The chief difficulty in measuring pressure of materials which are plastic or semi-fluid is that the materials themselves cannot be used to transmit pressure through small tubes. To overcome this difficulty, the line connecting the pressure gage with the pipe or chamber in which the pressure is to be measured, is filled with a suitable pressure transmitting fluid, such as water or oil, and means are provided for forcing a small quantity of this fluid through the connecting tube into the chamber in which the pressure is to be measured.

The accompanying sketch shows the



Schematic Representation of Pressure Gage and Auxiliary Equipment

principal features of the device. For occasional readings, the "injector," *F*, may consist of a cylinder containing a plunger driven by a screw and nut. When it is desired to take a reading the plunger is advanced a fraction of a turn, forcing a drop of liquid from the tube, *E*, into the chamber or pipe, *P*, where the pressure is to be measured. The pressure gage, *G*, is read at once. For continuous readings, or where a number of gages are required, the hand-operated injector, *F*, may be replaced by a pump.

In order to equalize the flow from such a pump through several parallel systems, a "let-down" coil of fine capillary tubing is inserted at *C* in each gage line supplied by the pump. The pump must be capable of maintaining a pressure of approximately twice the highest pressure to be measured and the "let-down" coil must have sufficient resistance to pass only a few drops of liquid per minute at these pressures.

Selection of the pressure transmitting fluid requires some thought. For very high pressures and where its presence in the product is not objectionable, glycerine forms an ideal liquid for the purpose. In working with soap either glycerine or water is suitable. For food products, water will generally be suitable. At high temperatures, oils may be used.

This method cannot be expected to yield results of great precision; in fact, the pressure conditions in a plastic solid under flow are far from uniform and probably vary widely from one instant to another, but the results obtained have been very useful in indicating the necessary strength of parts and in controlling flow. The method may also be used where suspensions such as paper pulp tend to clog gage lines.

*Formerly Research Engineer with Arthur D. Little, Inc., Cambridge, Mass.

Sonic Gas Purity Indicator

By Lawrence Hodges

Design Engineer Baltimore, Md.

IN SPECULATING about the determination of gas composition by some means capable of handling large volumes, it occurred to me that a method which has evidently been overlooked by engineers might be used satisfactorily. This development has never progressed beyond the "paper" stage, but I believe that a brief airing of its theory might prove suggestive or evoke discussion.

The thermal conductivity method of gas analysis is well known and requires no comment. I believe that gases can be analyzed more simply by measuring the velocity of sound in the gas mixture and from that determining the density. For constant temperature and pressure, the velocities, specific heats, and densities of two gases have the following relation

$$\frac{V}{V'} = \sqrt{\frac{Sd'}{S'd}}$$

where *V*, *S*, and *d* are respectively velocity, specific heat, and density of the first gas and *V'*, *S'*, and *d'* are comparable quantities for the second.

A simple means of measuring velocity of sound uses a resonant tube and an electrically vibrated tuning fork. This familiar experiment, it will be recalled, consists in determining the point of maximum resonance of a vibrating tuning fork which is held over the open mouth of a tube as the length of the tube is varied by lowering it into water. At the point of maximum sound, the tube length is one-quarter of the wave length. Hence four times the tube length, times the frequency of the fork, equals the wave length.

In using this principle, one method of varying the tube length would be to fit it with a piston, the position of which could be altered by a thumb-screw adjustment while the tube length was read on a scale by means of a vernier. The open end of the tube would be inserted in the gas line and the electrically driven fork suspended in front of the opening. Any form of electric microphonic device such as the sensitive element of a telephone transmitter could be used, together with a receiver, to determine the point of maximum resonance. Rough experiments have indicated that this point can be determined within about 0.04 in. of piston travel.

An indication of the accuracy that can probably be expected is shown by the following calculation. Assume a standard gas in which the velocity of sound is 1,100 ft. per second. Using a fork frequency of 100 per second, the tube length at maximum resonance is

$$\frac{12 \times 1{,}100}{100 \times 4} = 33 \text{ in.}$$

Assume the length with a test gas to be 33.4 in. (10 times the minimum detectable change), and assume also that the change in specific heat is negligible. Then

$$\frac{33}{33.4} = \sqrt{\frac{d'}{d}} \text{ or}$$

$$d' = 0.975d$$

Since a density difference of only one-tenth this magnitude can be detected, the method seems to offer distinct possibilities, provided always, of course, that provision is made for reducing all measurements to standard conditions of temperature and pressure, and that the density of the principal component differs sufficiently from that of the remaining gas or gases.

EQUIPMENT NEWS
FROM MAKER AND USER

Three-Roll Grinder

REMARKABLE results in grinding colors, paints, pastes, enamels, and other non-abrasive materials suspended in a vehicle, are claimed for the new Vasel Mill, produced by William Wharton, Jr., & Company, Easton, Pa. This mill was first shown at the Chemical Exposition in 1929. Since then it has been enlarged and improved, and carried through the developmental stage.

The principal feature of the new mill is a method of adjusting and maintaining pressure between the rolls by means of hydraulic pistons. The center roll of the three is permanently located with respect to the frame. The front and back rolls may be pressed against the center roll by turning handwheels which control the hydraulic pistons. There are two handwheels, one of which

Three-Roll Grinder Showing Adjustable Side Plate, Pressure-Control Handwheel and Pressure Gages for Indicating Roll Pressure

adjusts the pressure on the two hydraulic pistons which control the back roll, the other similarly controlling the two pistons which position the front roll. Pressure gages mounted as shown in the illustration in the two outer positions indicate the pressure per square inch on the pairs of rolls.

A second hydraulic system is set in operation when either of these rolls is backed off. This is controlled by the same handwheel. Its function is to separate the rolls. Pressure in this system is indicated by the two center gages.

Other features of the new grinder include the use of herringbone gears on both ends of each roll. Rolls are of chilled cast iron, internally water-cooled. They are lapped by hand to insure certain parallelism. The adjustable side plates between the back and center rolls are self-locating, and make contact with the ends rather than the sides of the roll, thus eliminating wear. The discharge apron moves with the front roll carriage so as to maintain constant pressure against the roll.

Advantages claimed for these various features include the possibility of perfectly reproducing the best conditions for any grinding problem at any time. The pressure control feature and the accuracy of the rolls have greatly increased production in many cases, according to the manufacturer. Improvement in the design of the front roll has eliminated throw-backs. The new grinding mill is being produced in standard sizes of 10x16, 12x30, 16x40, and 20x60 in.

Improved Hydrometer

GREATER ruggedness and less likelihood of breakage are incorporated in the "Nu-Typ" hydrometer manufactured by C. J. Tagliabue Mfg. Company, 540 Park Ave., Brooklyn, N. Y. The features of this new instrument include a streamline tip and a solid metal ballast of low-melting-point alloy anchored into the tip of the bulb by a constriction blown in the glass. According to the manufacturer, this reduces possibility of breakage, makes the hydrometer easier to clean, and at the same time gives a permanent and accurate ballast which cannot work loose. An additional advantage is the price reduction which has been made possible by the new construction.

Automatic Ratio Control

FOR MIXING gases or liquids in any desired proportion, Bailey Meter Company, Cleveland, Ohio, has announced a new automatic ratio controller of the hydraulic-pilot-operated type.

An accompanying illustration shows two Bailey gas meters which operate together to form the controller. They are used in mixing blast-furnace and coke-oven gas in constant proportions.

Ratio Controller Used for Mixing Fuel Gases in Constant Proportions

Samples of Rubber-Covered Steel Made by Thermoprene Process

The operation of the device is briefly as follows: The meters are of the floating-bell type, operated on the differential pressure produced by orifices in the two gas lines. One meter measures the flow of coke-oven gas and the other of blast-furnace gas. A linkage connects the pen-operating mechanism of the two recorders and by its position serves to adjust the position of a pilot valve to which oil under pressure is supplied. When the flow of coke-oven gas increases, the position of the linkage adjusts the pilot valve so as to admit oil above a piston connected to a damper in the blast-furnace gas line. This serves to open the damper slightly. Decrease in the coke-oven gas flow operates conversely, decreasing the opening of the damper.

To prevent hunting, the pilot valve is equipped with a stabilizer which opposes any change by tending to bring the pilot valve to the neutral position. As the damper setting approaches the proper value for the new conditions, the stabilizer tends to make an adjustment in the opposite direction and thus prevents overshooting.

An adjustment is provided in the linkage mechanism so that the ratio which gives a neutral position to the pilot valve may be instantly adjusted for any desired proportions of the two components being mixed.

Rubber-Covered Equipment

LICENSES for the use of the Thermoprene rubber-covering process, of the B. F. Goodrich Company, have been acquired by the Dorr Company, 247 Park Ave., New York, according to a recent announcement. Prior to the announcement, the Dorr Company had already applied 5,000 sq.ft. of rubber by this process to thickeners, agitators, rod mills, ball mills, pumps, filters, and similar industrial equipment.

Rubber stock ordinarily used in this process is a soft rubber having high resistance, according to the manufacturer, both to abrasion and to acid solutions, for temperatures up to the boiling

point. It is expected that the use of rubber covering will permit the company to build parts for its equipment of maximum strength and minimum cross-section, since it will no longer be necessary to contend with strength reduction due to corrosion.

Self-Lubricating Bearings

AN IMPROVEMENT in oil-less bearings, developed by W. C. Wilharm, of that organization, has been announced by the Westinghouse Research Laboratories, East Pittsburgh, Pa. It is claimed that the efficiency of these bearings is ten times that of the so-called "oil-less" bearings in use at present. The new bearing is adapted for use in machinery which turns over for a short time, and then is idle for a considerable period. It may also be used with the usual lubricants, and presents the advantage that it is capable of operating for a considerable time in the event of lubricant failure, due to its own inherent lubricating qualities.

The new bearing is a composite material formed of one or more metallic powders mixed with one or more materials yielding a soapy substance and molded first cold, and then hot, under very high pressure. It is understood that these bearings will be supplied either according to specifications or in the form of blanks which can be machined to size by the user.

Stainless Steel Wire Cloth

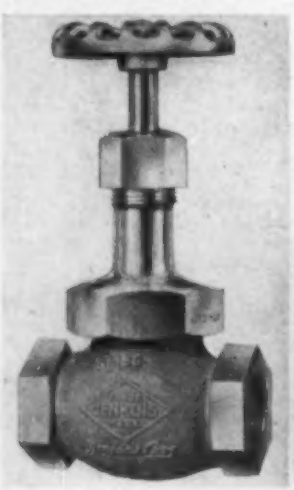
WIRE CLOTH woven from stainless steel is now being manufactured by the Newark Wire Cloth Company, 351 Verona Ave., Newark, N. J. This cloth is made in all meshes, widths, and lengths, and will be made as fine as 200x200, according to the manufacturer, provided quantity orders are sufficient to warrant this mesh.

Improved Bronze Valves

ONE-PIECE, screw-over bonnets and a special form of disk holder are features of a new line of standard bronze valves recently introduced by Jenkins Bros., 80 White St., New York. These valves are made in globe, angle, cross, and check types.

The one-piece bonnet construction is said to provide unusual strength, together with ease of removal. A novel form of disk holder known as the "Slip-On Stay-On" holder is so designed that when the spindle is raised a turn or two, the bonnet can be removed from the valve body without danger of the disk holder slipping off. After a turn or two in the opposite direction, the holder slips off the spindle easily.

New Bronze Globe Valve



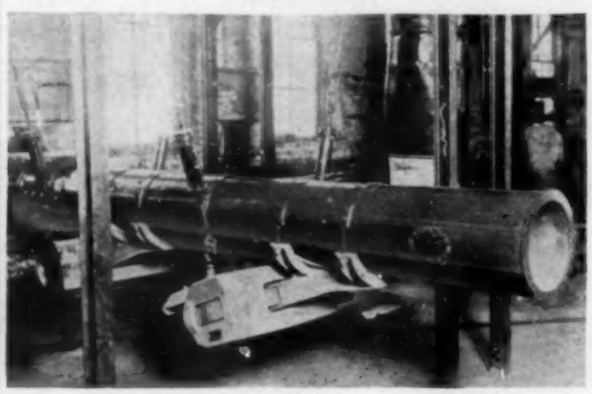
Vibrating Conveyors

EITHER HOT or cold materials may be handled dustlessly in a vibrating conveyor recently developed by the Traylor Vibrator Company, Denver, Colo. This conveyor is made in several forms, including an open-pan or launder conveyor and a line of tubular conveyors which includes water-cooled tubes, unjacketed tubes, and special combinations of conveyors and screening equipment. These conveyors may be adjusted to deliver material at any speed from zero to 50-60 ft. per minute and can handle material up an incline as great as 18 deg.

The vibrating mechanism is similar for the several types of conveyor. It consists of a heavy cast-iron frame supporting a multi-leaf spring to which the conveying tube or launder is attached. Attached also to this spring is the electrical vibrating mechanism, consisting of an electromagnet and an armature. This is connected to a source of alternating current which, at maximum amperage, causes a conveyor vibration amplitude of about $\frac{1}{16}$ in. Forward motion of the conveyor is slightly upward and backward motion slightly downward, so that the material moves in the forward direction. For speed adjustment, the company furnishes a small motor-generator which operates on any standard alternating current. This may be instantly adjusted by the operator to give any desired amplitude of vibration and hence any conveying speed from zero to the maximum.

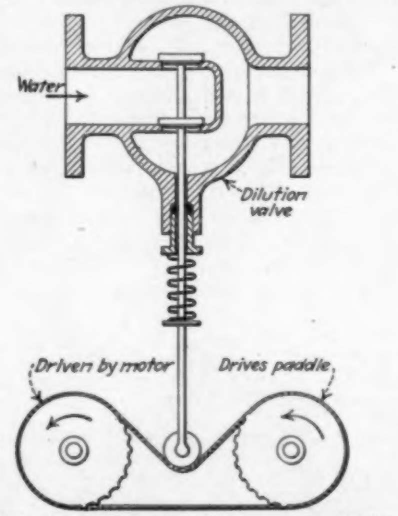
Among advantages, the manufacturer claims ability to handle materials as hot as 2,000 deg. F. in the cooling type, with practically no wear, even from very abrasive materials. Maintenance is said to be low, and there are no points requiring lubrication. Conveyors range in size from 10 to 46 in. diameter in the tubular and 10 to 48 in. width in the pan type. Capacities range upward to 200 tons per hour.

Single Length of Water-Cooled Tubular Conveyor for Hot Materials



Pulp Consistency Controller

FOR REGULATING the percentage of water in paper stock going to the paper machines, a novel consistency controller has been devised by the Merritt Engineering & Sales Company, Lockport, N. Y. This was described at the recent fall meeting of T.A.P.P.I. The controller consists of a box in which is a rotating paddle driven through a special form of drive. Stock is admitted

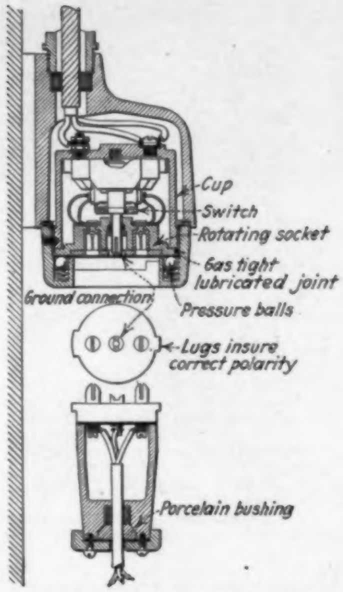


Schematic Representation of Transmission and Dilution Valve of Consistency Controller

to the box, where water for dilution is added under control of the device. This control is based upon the resistance to turning exerted by the paddle. An electric motor drives a slack chain running over two sprockets. One sprocket is connected to the motor and the other to the paddle. A roller riding on the slack side of the chain is connected to a balanced valve. Increase in the consistency, with resultant increase in power required to turn the paddle, tightens the slack chain and opens the valve, admitting more water to the stock. This is indicated diagrammatically in the accompanying drawing.

Vapor-Proof Receptacle

IN AN accompanying drawing, there is shown a new vapor-proof electric plug and receptacle, a Swedish development, which is being marketed in this country by Alfred Hague & Company, 130 West 42d Street, New York. A principal feature of this device is that the circuit must be disconnected by turning the socket in the receptacle through an angle of 90 deg. before the plug can be removed. Thus, it is impossible to arc at the plug contacts when the plug is withdrawn. The receptacle is carefully sealed at all points, a lubricated joint making it tight against flammable



Vapor-Proof Plug and Receptacle for Use in Flammable Atmospheres

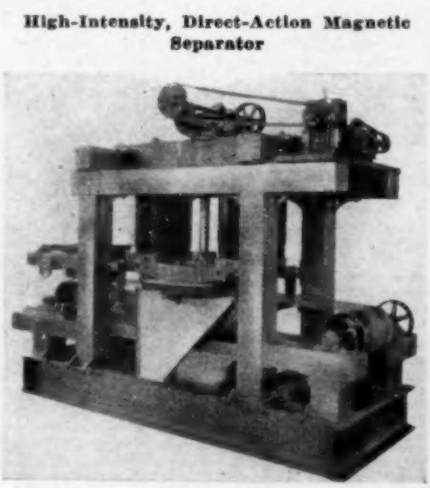
gases where the rotating part comes in contact with the cup. Pressure balls insure continuing tightness at this point.

The plug also is constructed with regard to safety in flammable atmospheres. All joints are gasketed and the cable is clamped by means of a porcelain bushing and sealed with a rubber collar. It will be noted that the device also includes a ground connection. It is made in two sizes: (1) two poles, 10 amp., 150 volts, and (2) three poles, 15 amp., 500 volts, in the type shown and in a flush model. All insulating parts are constructed of a molded, reinforced phenol-formaldehyde compound.

Direct-Action Magnetic Separator

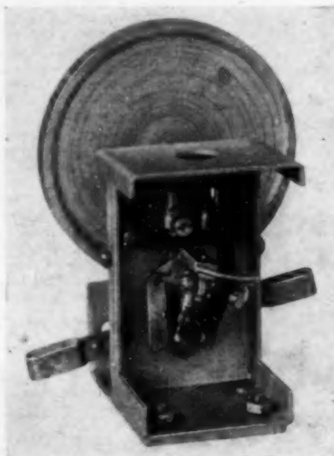
HIGHLY RELUCTANT magnetic materials may be separated from non-magnetic material, according to the Magnetic Manufacturing Company, Milwaukee, Wis., by means of a new magnetic separator of its manufacture. As shown in the accompanying illustration, the machine consists of a heavy framework supporting two powerful electromagnets above a rotating disk. Beneath the disk a belt conveyor carries the material to be separated. This disk consists of a ring surrounding a disk of non-magnetic bronze. Magnetic material which is attracted to the disk is carried outward by the rotation and discharged onto specially constructed chutes at the sides of the separator. Construction is such that the magnetized ring becomes neutralized as it revolves over the discharge chutes, automatically releasing the magnetically separated material.

High-Intensity, Direct-Action Magnetic Separator



In this machine, the air gap has been reduced to the minimum. The magnets each have 140,000 amp. turns and are thus able to exert a magnetic pull of very high intensity. The magnet assembly alone weighs 12,000 lb.

The separator is a complete, self-contained unit, including a motor and speed reducer. It requires no accessory equipment for operation. Its capacity varies according to the materials to be processed.



New Mercury Float Switch

New Electrical Equipment

NEW ADDITIONS to its line of photo-electric relays and a new float switch have been announced by the General Electric Company, Schenectady, N. Y. An alternating-current relay for interior use has previously been on the market. Among the new relays are both direct-current and alternating-current devices, the latter for both interior and outdoor use and the former for indoor use only. The outdoor instruments are of weatherproof construction. There is also a special type of relay for turning on and off lights inside buildings, dependent upon the amount of natural illumination available. The line also includes light sources for interior and exterior work, for use with photo-electric relays which operate by the interruption of a beam of light.

The new float switch (CR-2931-U) uses an inclosed mercury switch in making and breaking circuits through motors of ½ hp. a.c. or ¼ hp. d.c. The switch is used for maintaining level in tanks. The mercury switch is of the type in which contact is broken between pools of mercury in an atmosphere of inert gas.

Other developments include two new lines of motors both of which are fully inclosed and fan-cooled. One line is intended for use in hazardous atmospheres, as in gasoline refineries, paint factories, and alcohol plants The line includes polyphase induction motors in sizes from ¾ to 30 hp. and single-phase motors from ¼ to 2 hp. These motors comply with the requirements for use in Class 1, Group D, and Class 2 hazardous locations. The second line of motors provides a fully inclosed motor of the same mounting dimensions, rating for rating, as open type motors, in sizes from ¾ to 50 hp. They are intended for use in hazardous dust conditions, specified as Class 2 in the National Electric Code.

Tank Lining Material

A NEW acid-resistant material for application in fluid or plastic form has recently been developed and placed upon the market for use as a jointing compound in bell and spigot cast-iron water mains and for lining tanks made of concrete. The new material may also be used for pointing joints in acid-proof masonry.

This material, known as "Mineralead," has been developed during the last two years by the Kobbé Laboratories, Inc., 114 East 32d St., New York, and is being produced and marketed by The Atlas Mineral Products Company, Mertztown, Pa.

Mineralead is marketed in the form of 10-lb. ingots. The material has a melting point of 113 deg. C. and in use it is only necessary to melt a sufficient number of ingots and apply the melted product, either in the fused or plastic state, to the work. The base of this material is sulphur, which gives it, according to the claim of the manufacturers, almost complete resistance to most acids. It differs from materials previously in use, such as the familiar sulphur-sand mixtures, in that it does not separate upon standing in the fluid condition, thus, it is said, assuring a uniform composition when the cement has hardened. Another advantage claimed for Mineralead is that its shrinkage upon cooling is negligible, so that joints or linings made with the material are free from shrinkage cracks and pinholes.

In the tests which have been made with Mineralead thus far, excellent resistance to certain strengths of all acids except hydrofluoric has been indicated. Hydrochloric and phosphoric acids of any strength, most organic acids of any strength, and dilute sulphuric and nitric acids are among the acids which have been successfully handled in this material. Temperature, however, is a limiting factor, as Mineralead is not recommended for temperatures above 100 deg. C.

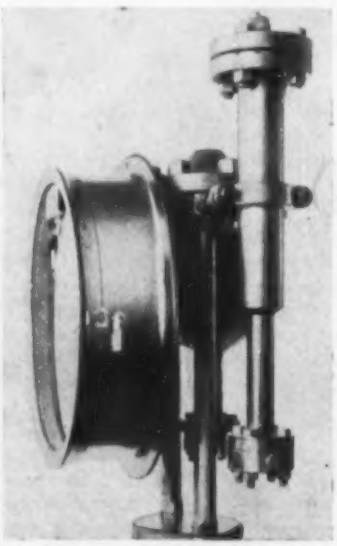
A considerable quantity of Mineralead is already in use as a jointing material for water-supply piping. Tests conducted by one of the largest water-

supply systems in the country showed a decided superiority for the new material over lead caulking. Strength was considerably higher. No industrial applications have as yet been made with the material as a tank lining, but preliminary tests indicate that a strong and very resistant surface is produced.

In the use of Mineralead for lining concrete tanks, the material, heated to the liquid state, and flowed onto the natural concrete surface with a fiber brush. Three coatings suffice to give a thickness of $\frac{1}{8}$ to $\frac{1}{4}$ in. This is believed to be sufficient for most purposes. As a lining for concrete, Mineralead is easier to apply than lead and is said to be very considerably cheaper. Among the uses which have been suggested for large-scale trial of the material are: electrolytic cells, tanks for phosphoric acid, storage and process tanks for chamber sulphuric acid, and similar applications.

High-Pressure Flow Meters

AS A COMPANION to the 5,000-lb. flow meter announced in the February, 1930, issue of *Chem. & Met.*, the Foxboro Company, Foxboro, Mass., has just brought out a new high-pressure recording flow meter built for



New Recording Flow Meter for Pressures to 2,500 Lb.

operating at pressures up to 2,500 lb. per square inch. In this instrument, the manometer is built of drop forgings. The instrument is available in a single-pen recorder; a double-pen recorder when a static pressure record is desired; an integrating instrument reading directly in terms of flow; and a controlling and recording instrument.

New Synchronous Motors

A RECENT announcement of Fairbanks, Morse & Company, 900 South Wabash Ave., Chicago, concerns the establishment of a complete line of synchronous motors covering a range of ratings from 20 to 10,000 hp. in both low- and high-speed types. The motors are equipped with anti-friction bearings and stators with cast semi-steel skeleton frame ends. These are pressed together under hydraulic pressure, inclosing the stator cores, and are held together by welding the stacking pins to form a flat, countersunk head. This construction, it is said, completely eliminates the loosening of the stator cores and the vibration and fatigue breakage of the stator teeth. In addition to these advantages, high efficiency both at full and partial loads is claimed, together with a simple requirement in starting equipment.

Manufacturers' Latest Publications

Chemicals. International Filter Co., 50 E. Van Buren St., Chicago, Ill.—Bulletin describing water purification with Hydrodarco, a carbon.

Chemicals. Pfaltz & Bauer Chemical Co., 300 Pearl St., New York—63-page booklet, listing chemicals and laboratory equipment.

Chemicals. Sierra Talc Co., 428 Union League Bldg., Los Angeles, Calif.—Descriptive folder on production of various grades of talc.

Electrical Equipment. The Esterline-Angus Co., Indianapolis, Ind.—No. 930 of "The Graphic," on portable current transformer.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Bulletins as follows: CR-2904A1 on phase protective Panels; GEA-529A on Low speed synchronous motors; GEA-37F on direct heat electric furnaces; GEA-1174B on conveyor furnace; GEA-1324 on air-draw furnaces; GEA-1299 on flood lighting; GEA-1177B on oil immersion heaters, and GEA-1206 on general flood lighting.

Equipment. Parks-Cramer Co., 1102 Old South Bldg., Boston, Mass.—Folder on jacketed pipe and fittings.

Equipment. Stacey Bros. Gas Construction Co., 420 Lexington Ave., New York—Bulletin No. 32 on Stacey high pressure bullets and other holders.

Equipment. Schutte & Koerting Co., 12th & Thompson Sts., Philadelphia, Pa.—New edition of bulletin No. 4-P on water jet exhausters, attractive and well-illustrated.

Instruments. The Foxboro Company, Foxboro, Mass. Bulletin No. 168 on recording gages, with steel springs and welded movement.

Instruments. Roller-Smith Co., 233 Broadway, New York.—Catalog No. 48 on switchboard instruments, thermocouples, and transformers.

Laboratory Services. Pittsburgh Testing Laboratory, Stephenson & Locust Sts., Pittsburgh, Pa.—A brochure outlining the professional services and facilities of this company.

Materials. Johns-Manville Corp., 292 Madison Ave., New York—Well-illustrated booklet on corrugated Transite for building purposes.

Materials Handling. American Car & Foundry Co., 30 Church St., New York—Bulletin No. 101, containing data on industrial railways.

Materials Handling. Richardson Scale Co., Clifton, N. J.—Bulletin 9130 on storage bins, chutes and control gates.

Metals. General Electric Co., Schenectady, N. Y.—75-page booklet on equipment and methods of heat treatment of steel.

Metals. International Nickel Co., Inc., 67 Wall St., New York—Directory of manufacturers, fabricators and distributors of nickel alloy steel products.

Metals. United Drydocks, Inc., New York, N. Y.—Folder on "Unidock" lead-lining for larger equipment.

Metal Cleaning. The Magnus Chemical Co., Inc., Garwood, N. J.—Complete 76-page booklet describing processes, methods and materials with practical suggestions.

Metal Plating. Meaker Co., Chicago, Ill.—Booklet on full automatic "Straight-A-Way" and return type plating machines.

Metal Plating. Hanson-Van Winkle-Munning Co., Matawan, N. J.—Bulletin No. M-104 on the company's Mercel type plating barrels.

Metal Testing. E. Leitz, Inc., 60 E. 10th St., New York—Catalog No. 1057 describes advances made in the micrometallograph.

Mixing. The Turbo-Mixer Corp., 250 E. 43d St., New York—Illustrated booklet on construction and uses of the company's products.

Ovens. Despatch Oven Company, Minneapolis, Minn.—Bulletin No. 11 on continuous conveyor ovens.

Power Generation. Combustion Engineering Corp., 200 Madison Ave., New York—Descriptive catalog of type E stoker of the center retort underfeed type.

Power Transmission. Cleveland Worm & Gear Co., Cleveland, Ohio—Illustrated pamphlet on installation and lubrication of Cleveland Worm Gear Reduction Units.

Power Transmission. Foote Bros. Gear & Machine Co., 111 N. Canal St., Chicago, Ill.—Catalog 102, giving applications and data on Titan herringbone and helical speed reducers.

Power Transmission. Link-Belt Co., 910 So. Michigan Ave., Chicago—New data book No. 1050 on the new metal, Promal, for chains.

Power Transmission. Ohio Gear Co., 1333 East 179th St., Cleveland, Ohio.—96-page catalog of smaller gears and information relating to them.

Power Transmission. Worthington Pump & Machinery Corp., Harrison, N. J.—Bulletin L-400 illustrating and describing the new Multi-V-Drive, made in conjunction with the Goodyear Company.

Process Equipment. J. P. Devine Mfg. Co., Mt. Vernon, Ill.—Illustrated and technical description of the new Pratt process for manufacturing anti-knock blending fluid.

Pumps. Chicago Pump Co., 2336 Wolfram St., Chicago, Ill.—Bulletin 16—Describes pumps for municipalities including sewage, drainage, water supply and similar pumps; also bulletin briefly describing other centrifugal pumps, pneumatic water systems, condensate pumps and drainage pumps made by this company.

Pumps. Pennsylvania Pump & Compressor Co., Easton, Pa.—Bulletin No. 151, on Duplex air and gas compressors, with illustrations and numerical data.

Pumps. Wilbraham-Green Blower Co., Pottstown, Pa.—Bulletins G-15, S-16, I-14, and F-13, respectively on gas exhausters and gas pumps, new cupola blower, high-duty blower and rotary cupola blower.

Refractories. Ironton Fire Brick Co., Ironton, Ohio—Folder briefly describing the firebrick made by this company and the various grades which the company supplies.

Safety. Lockwood Greene Engineers, Inc., 10 East 42d St., New York—Booklet on facts about fire insurance for industry.

Safety. Mine Safety Appliances Co., Pittsburgh, Pa.—Catalog No. FA-2, a comprehensive 36-page catalog of all first-aid materials for industrial uses.

Sampling. Hills-McCanna Co., 2349 Nelson St., Chicago, Ill.—Folder describing the Hills-McCanna composite liquid sampler for determining the average contents of tanks.

Steam Generation. Foster-Wheeler Corp., 165 Broadway, New York—Bulletin WB-30-2—Describes waste heat boilers with extended surface tubes, for heat recovery from Diesel engine exhaust or other hot gases, and for operation either as flash or ordinary type boilers.

Strainers. Schutte-Koerting, Philadelphia, Pa.—Bulletin No. 9-S on strainers for oil, water, steam, etc., with a well-illustrated text.

Vacuum Pumps. F. J. Stokes Machine Co., Olney P. O., Philadelphia, Pa.—Bulletin 149—Completely describes a new high vacuum pump operating on the rotary principle.

Welding. American Rolling Mill Co., Middletown, Ohio—40-page booklet covering the use of Armco ingot iron in fusion and forge welding. Also Armco Engineering Bulletin No. 4, giving A.S.T.M. specifications for open hearth iron plates of flange quality.

Welding. Alloy Welding Processes, Ltd., Forest Road, London, England—Paper on "The Welding of Monel Metal and Pure Malleable Nickel," by N. C. Marples.

Welding. Fusion Welding Corp., 103d St. and Torrence Ave., Chicago, Ill.—Folder concerning Weldite "Green-Surfaced" welding rods for the electric welding of mild steel. Describes the purpose of green surfacing and explains why this treatment reduces cost.

Welding. General Electric Co., Schenectady, N. Y.—Small booklet on welding electrodes and accessories.

Wood Protection. Aluminum Co. of America, Pittsburgh, Pa.—28-page booklet describing the use of aluminum paint for the protection of wood, showing many actual photographs of buildings primed with aluminum paint, after several years exposure.

PATENTS ISSUED

Oct. 7 to Oct. 28, 1930

Paper and Pulp

Method for Producing Low-Density Pulp. Leon W. Babcock, Kenvil, N. J., assignor to Hercules Powder Company, Wilmington, Del.—1,777,710.

Manufacture of Pulp. John Neumann, Chicago, Ill.—1,778,199.

Method for Recovery of Rosin Soap Material from Spent Wood Liquors. Viggo Drewsen, Larchmont, N. Y., assignor to West Virginia Pulp & Paper Company, New York, N. Y.—1,778,523.

Cellulosic Composition. Ebenezer Emmet Reid, Baltimore, Md., and George L. Schwartz, Wilmington, Del., assignors to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,778,567.

Treatment of Black Liquor. Linn Bradley, Montclair, N. J., and Edward P. McKeefe, Plattsburg, N. Y., assignors to Bradley-McKeefe Corporation, New York, N. Y.—1,779,226.

Method of Processing Black Liquor and Product Derived Therefrom. Edward G. Goodell, Stevens Point, Wis.—1,779,768.

Paper Product and Its Manufacture. Ernest Hopkinson, New York, N. Y., assignor to Mechanical Rubber Company, Cleveland, Ohio.—1,779,772.

Rubber and Rayon

Manufacture of Vulcanized Rubber and of Materials for Use Therein. Cecil John Turrell Cronshaw and William Johnson Smith Naunton, Blackley, Manchester, England, assignors to British Dyestuffs Corporation, Ltd., Blackley, Manchester, England.—1,777,352.

Rubber Composition and Method of Preserving Rubber. Clayton W. Bedford, Akron, Ohio, assignor to B. F. Goodrich Company, New York, N. Y.—1,777,634.

Rubber-Vulcanization Process. Winfield Scott and William P. ter Horst, Akron, Ohio, assignors to Rubber Service Laboratories Company, Akron, Ohio.—1,777,737.

Process of Vulcanizing Rubber and Product Thereby Obtained. Winfield Scott, Nitro, W. Va., assignor to Rubber Service Laboratories Co., Akron, Ohio.—1,777,738.

Process of Treating Rubber and Product Obtained Thereby. Sidney M. Cadwell, Leonia, N. J., assignor to Naugatuck Chemical Company, Naugatuck, Conn.—1,777,874.

Process of Treating Rubber Latex. Frederick H. Untiedt, Chevy Chase, Md.—1,777,945.

Process of Vulcanizing Rubber and Products Obtained Thereby. Sidney M. Cadwell, Leonia, N. J., assignor to Naugatuck Chemical Company.—1,777,960.

Manufacture of Artificial Silk. Friedrich Wilhelm Schubert, Apperley Bridge, near Bradford, England, assignor to Brysilka, Ltd., Apperley Bridge, near Bradford, England.—1,778,301-2.

Method of Compounding Rubber. William S. Calcott and William A. Douglass, Penns Grove, N. J., and Miles A. Dahlen, Wilmington, Del., assignors to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,778,548.

Process of Treating Rubber and Product Obtained Thereby. Sidney M. Cadwell, Leonia, N. J., assignor to Naugatuck Chemical Company, Naugatuck, Conn.—1,778,-707-9.

Method of Vulcanizing Caoutchouc and the Product Derived Therefrom. Lorin B. Sebrell, Akron, Ohio, assignor to Goodyear Tire & Rubber Company, Akron, Ohio.—1,779,375.

Antioxidant or Age Resister. Albert M. Clifford, Akron, Ohio, assignor to Goodyear Tire & Rubber Company, Akron, Ohio.—1,779,390.

Manufacture of Rubber Vulcanization Accelerators. Winfield Scott, Akron, Ohio, assignor to Rubber Service Laboratories Company, Akron, Ohio.—1,779,715.

Process of Vulcanizing Rubber and Accelerator Therefor. Donald H. Powers, Penns Grove, N. J., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,780,149.

Petroleum Products and Technology

Art of Cracking Hydrocarbons. Eugene C. Herthel, Chicago, Ill., and Harry L. Pelzer, Highland, Ind., assignors to Sinclair Refining Company, New York, N. Y.—1,777,307.

Process of Purifying Hydrocarbons. Wilson H. Low, Long Beach, Calif., assignor, by mesne assignments, to Richfield Oil Company of California, Los Angeles, Calif.—1,777,619.

Apparatus for Distilling Liquid Hydrocarbons. Nathan E. Merrill, Long Beach, Calif.—1,778,269.

Distillation of Hydrocarbon Oils. William H. Bahlke, Whiting, Ind., assignor to Standard Oil Company, Whiting, Ind.—1,778,445.

Process of Distilling Mineral Oil Under a High Vacuum. Arthur E. Pew, Jr., Bryn Mawr, Pa., assignor to Sun Oil Company, Philadelphia, Pa.—1,778,565.

High-Compression-Motor Fuel. Philip S. Danner, Point Richmond, and John E. Muth, Berkeley, Calif., assignors to Standard Oil Company of California, San Francisco, Calif.—1,779,061.

Plant for the Treatment of Hydrocarbons. Louis Bond Cherry, Louisville, Ky., assignor, by mesne assignments, to C & C Developing Company, Kansas City, Mo.—1,779,356.

Hydrocarbon-Oil Conversion. Carbon P. Dubbs, Wilmette, Ill., assignor to Universal Oil Products Company, Chicago, Ill.—1,779,465.

Apparatus for Distilling Hydrocarbon Oils. Harry G. Schnetzler, Whiting, Ind., assignor to Standard Oil Company, Whiting, Ind.—1,779,918.

Inorganic Processes

Hydrogen Generator. Carl Miedbrodt, Berlin-Rosenthal, Germany.—1,777,444.

Process for the Treatment of Phosphoric Acid. Charles F. Booth, Anniston, Ala., assignor, by mesne assignments, to Swann Research, Inc., Birmingham, Ala.—1,777,548.

Process for the Purification of Aluminous Oxide. Jacob S. Masin, Anniston, Ala., assignor, by mesne assignments, to Swann Research, Inc., Birmingham, Ala.—1,777,-570.

Smelting of Phosphatic Material in an Electric Furnace. Warren R. Seyfried, Anniston, Ala., assignor, by mesne assignments, to Swann Research, Inc., Birmingham, Ala.—1,777,582.

Fertilizer with a Base of Phosphate and Sulphur. Baptistin Bodrero, Paris, France.—1,777,908.

Producing Alumina. Eduard Carl Marburg, deceased, Griesheim-on-the-Main, Germany, by Anna Marburg, administratrix, Griesheim-on-the-Main, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfort, Germany.—1,778,083.

Production of Calcium-Aluminate Cements and Fertilizer Materials. Herbert H. Meyers, Pittsburgh, Pa., assignor to Armour Fertilizer Works, Chicago, Ill.—1,778,224.

Process for Increasing the Potassium Salt Content of Distiller's Waste. Karel Cuker, Tavikovice, Czechoslovakia.—1,778,381.

Method of Improving the Properties of Activated Bauxite and Product Thereof. Raymond C. Benner, Niagara Falls, and Alfred Paul Thompson, Jackson Heights, N. Y., assignors to General Chemical Company, New York, N. Y.—1,778,517.

Device for Detecting Oxygen in Hydrogen. Gaylord W. Penney, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company.—1,778,834.

Pigment. Edward C. Holton, Olmsted Falls, Ohio, assignor to Sherwin-Williams Company, Cleveland, Ohio.—1,778,975.

Method of Testing the Flammable Condition of a Mixture of Air or Oxygen with a Flammable Gas or Vapor. Norman J. Thompson, Wellesley Hills, Mass.—1,779,-569.

Method of Separating Calcium and Magnesium Chlorides. Albert Kelvin Smith, Midland, Mich., and Carl F. Prutton, East Cleveland, Ohio, assignors to Dow Chemical Company, Midland, Mich.—1,780,098.

Hypochlorite Bleaching Composition. Lloyd T. Howells, Cleveland, Ohio, assignor to Electric Smelting & Aluminum Company, Cleveland, Ohio.—1,779,274.

Organic Processes

Apparatus for Separating and Recovering Vapors and Gases with Adsorbent Carbon. Oscar L. Barnebey, Columbus, Ohio, assignor to American Solvent Recovery Corporation.—1,777,460.

Process of Preparing Butadiene. Elmer K. Bolton, Wilmington, Del., and Frederick B. Downing, Carneys Point, N. J., assignors to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,777,600.

Treating of Animal-Skin Products. Antonio Ferretti, Milan, Italy, assignor to Societá Invenzioni Brevetti Anonima Torino, Turin, Italy.—1,777,831-9.

Process for Manufacturing Benzol and Valuable Byproducts from Butane, Propane, or Ethane, or Mixtures Thereof. Frank Porter, Ponca City, Okla., assignor, by mesne assignments, to Continental Oil Company, Ponca City, Okla.—1,777,894.

Manufacture of Activated Carbon. Richard Threlfall, Birmingham, England.—1,777,943.

Process of Oxidizing Acetaldehyde to Acetic Acid. Sydney William Rowell and Herbert Sim Hirst, Norton-on-Tees, England, assignors to Imperial Chemical Industries, Ltd., London, England.—1,778,511.

Art of Treating Shale or the Like. William Huntley Hampton, Portland, Ore.—1,778,515.

Gelignite and Gelatin Dynamite. Roy Linden Hill, Wilmington, Del., assignor to Atlas Powder Company, Wilmington, Del.—1,778,718.

Bituminous Emulsion. George Samuel Hay, London, England, assignor, by mesne assignments, to Flintkote Roads, Inc., Boston, Mass.—1,778,760.

Process for the Production of Citric Acid by Fermentation. Franz Kanhäuser, Kaznejoy, near Pilzen, Czechoslovakia, assignor to Montan- und Industrial-Werke vormals Joh. Dav. Starck, Dolni Rvchnov, near Falknov, Czechoslovakia.—1,779,001.

Desulphurization of Gas. Frederick W. Werner and Ernest T. Johnston, Joliet, Ill.—1,779,024.

Art of Spray Drying Soap. Earl P. Stevenson, Newton, and Ben B. Fogler, Belmont, Mass., assignors to Arthur D. Little, Inc., Cambridge, Mass.—1,779,516.

Sprayed Soap Product. Earl P. Stevenson, Newton, and Ben B. Fogler, Belmont, Mass., assignors to Arthur D. Little, Inc., Cambridge, Mass.—1,779,517.

Absorbent Material for Explosives and Resulting Explosives. Herbert C. Bugbird, Richmond, N. Y.—1,779,530.

Production of Acetone from Acetylene. Jerome Martin and Ignace J. Krchma, Terre Haute, Ind., assignors to Commercial Solvents Corporation, Terre Haute, Ind.—1,779,676.

Manufacture of Nitrostarch. Oscar Asa Pickett, Kenvil, N. J., assignor to Hercules Powder Company, Wilmington, Del.—1,779,825.

Process of Neutralizing Washed Light Oil. Joseph J. Lawton, Syracuse, N. Y., assignor to Semet-Solvay Company, New York, N. Y.—1,779,944.

Chemical Engineering Equipment

Apparatus for Making Gas. Frederick C. Freeman, Providence, R. I.—1,777,301.

Valve Mechanism. Lester M. Goldsmith, Highland Park, Pa.—1,777,303.

Filtering Material. Henry Blumenberg, Jr., Los Angeles, Calif.—1,777,546.

Method for Maintaining Uniformity in Composition Liquid of Dispersions or Emulsions. Paul Klein, Budapest, Hungary: Andrew Szegvári, Akron, Ohio, and Stephen Gotléb, Budapest, Hungary, assignors to American Anode, Inc., Akron, Ohio.—1,777,646.

Material Feeding and Weighing Device. Sidney Hausman, Arlington, N. J.—1,777,670.

Bubble Cap for Gas and Liquid Contact Apparatus. Clive M. Alexander, New Orleans, La.—1,777,869.

Mixing Apparatus. James Peters, Roslyn Heights, N. Y., assignor to Turbo-Mixer Corporation, New York, N. Y.

Chemical Loop Drier. Alpheus O. Hurxthal, Philadelphia, Pa., assignor to Proctor & Schwartz, Inc., Philadelphia, Pa.—1,777,972.

Distillation Apparatus. David T. Williams, Paterson, N. J.—1,778,177.

Gas Scrubber. Arthur G. McKee, Cleveland, Ohio.—1,778,426.

Tunnel Kiln. Oscar L. Barnebey, Columbus, and Merritt B. Cheney, deceased, Briggsdale, Ohio, by Josephine B. Cheney, administratrix, Briggsdale, Ohio.—1,778,-747.

Centrifugal Apparatus. Hubert M. Spross, Poughkeepsie, N. Y., assignor to Industrial Associates, Inc., New York, N. Y.—1,779,296.

NEWS of the INDUSTRY

Strong Technical Program For New Orleans Meeting

HYDROGENATION, natural gas, pulp and paper, petroleum, and sugar are some of the industries to be featured in the technical program at the winter meeting of the American Institute of Chemical Engineers, to be held in New Orleans, Dec. 8-10. Under the chairmanship of R. T. Haslam, of the Standard Oil Development Company, the program committee has announced a preliminary schedule that includes the following papers: "Application of Hydrogenation in Oil Refining," by M. W. Boyer, director of research, Standard Oil Company of Louisiana; "The Uses of Hydrogen in the Chemical Industry," by Carlton Ellis, consulting chemical engineer; "Ammonia as a Source of Hydrogen and Nitrogen," by J. F. T. Berliner and George W. Burke, of the Du Pont Ammonia Corporation; "Long-Distance Transportation of Natural Gas," by Edward G. Hill and George I. Rhodes, of Ford, Bacon & Davis; "Temperature - Vapor Pressure Relationships of Petroleum Products," by S. D. Turner and J. E. Pollock, of the Humble Oil & Refining Company; "Sodium Metasilicate as an Industrial Alkali," by J. G. Vail, of the Philadelphia Quartz Company; "Exploded Wood for Insulating and Structural Materials," by Robert M. Boehm, of the Masonite Corporation; "Aluminum Chloride and the Friedel-Crafts Reaction," by P. H. Groggins, Color Laboratory, U. S. Department of Agriculture; "Mixing of Gases for Reaction," by T. H. Chilton and R. P. Genereaux, of E. I. Du Pont De Nemours & Company; "Celotex—Its Manufacture and Uses," by E. C. Lathrop, Celotex Company; "Some Engineering Features of the Naval Stores Industry," by Croswell and Rockwell, of the Hercules Powder Company; "Chemical Engineering Advances in the Cane Sugar Industry," by George P. Meade, Colonial Sugars Company; "Development of Paper Manufacture From Southern Pine," by R. H. Stevens, Bogalusa Paper Company.

Prof. C. S. Williamson, Jr., of Tulane University, general chairman, assisted by the members of the local committee, have completed arrangements for the social and industrial features of the convention, which will have its headquarters at the Hotel Roosevelt. The industrial excursion will take the party by bus along the Teche, through the romantic parts of Louisiana, and show them many of the industrial possibilities of that interesting part of the country. It is probable that visits will be made to salt mines, a sugar house, rice mill, oil fields, an oil refinery, a super power plant, and possibly the sulphur mines of the Gulf Coast.

New Alkali Plant For South

THE Pittsburgh Plate Glass Company announces an alliance with the American Cyanamid Company, for the development of certain chemical products now manufactured by them separately. These companies are not competitive in the manufacture of these products, but the Cyanamid company and its subsidiaries, as well as the Pittsburgh Plate Glass Company, are large consumers of soda ash and caustic soda, which the latter company now produces. The arrangement involves, among other things, the erection jointly by the two principal companies of a new soda ash and caustic soda plant on tidewater in the South, where raw materials are available at low costs. Pending the construction of the new soda ash plant Pittsburgh Plate Glass Company and Cyanamid company and its subsidiaries will obtain their requirements of alkalis from the Columbia Chemical Division of the Pittsburgh Plate Glass Company, located at Barberton, Ohio.

Manganese Producers Seek Embargo

DOMESTIC producers of manganese, through the American Manganese Producers' Association, have lodged a petition with the Treasury Department seeking an embargo on importations of manganese from Russia.

The petition states that an alliance has been formed between the American Iron and Steel Institute and Soviet Russia which is "stifling and throttling" the development of domestic manganese.

The brief contends that it costs $23.75 to deliver a ton of manganese ore from Russia to United States Atlantic ports without the tariff duty and that this ore is sold at $12.50 per ton in order to break down the American industry. "This dumping has paralyzed the American manganese industry, suspending plant operations and construction, and caused further unemployment," the brief concluded.

Dr. Frolich Receives Grasselli Medal

THE Grasselli Medal was awarded to Dr. Per K. Frolich, of the Standard Oil Development Company, at a joint meeting of the Society of Chemical Industry, the American Chemical Society, the American Electrochemical Society, and Société de Chimie Industrielle on Nov. 7, 1930. Prof. D. V. Jackson, Columbia University, presided at the meeting and Prof. W. K. Lewis, Massachusetts Institute of Technology, made the presentation address.

The medalist addressed the members on "Pressure as a Tool in the Chemical Industry of the Future." In pressure, he said, the chemist has discovered a tool with which he is now rapidly opening up a new field of industrial activity. As a means of short-cutting the traditional step-by-step methods of organic chemistry, pressure seems to offer remarkable opportunities. The ancient barrier between aliphatic and aromatic chemistry has been broken down by pressure. This being so, the chemist is justified in concluding that the chemical industry of the future will have other sources than coal tar from which to obtain its raw materials for dyestuffs and numerous other aromatic derivatives.

There is no chemical reason why dyestuffs should not be produced out of the abundant supply of natural water gas by building them up through the addition of hydrogen under high pressure. In the same manner, we should be able to produce synthetic fats and protein from water gas and it should also be possible to produce a synthetic material much closer to silk than rayon by the same building up process, according to Dr. Frolich.

Permutit Loses Suit Involving Patent

THE Circuit Court of Appeals has handed down a decision in the case of the Permutit Company against the Graver Corporation in which the decree of the District Court for the Northern District of Illinois was affirmed. In the District Court the Permutit Company charged infringement of claims 1 and 5 of the Gans patent covering an apparatus "for softening of water." The District Court dismissed the case on the ground that the claims were invalid. The case was appealed, and the decision of the lower court was sustained.

Technical Committees of M.C.A. Meet in New York

SEVERAL of the important technical committees of the Manufacturing Chemists' Association met in New York during the week of Nov. 10 at sessions called by Warren N. Watson, executive secretary. The carboy committee, under the chairmanship of M. F. Crass, of the Grasselli Chemical Company, Cleveland, Ohio, has continued its work on standardization, which has resulted in the abandonment of all except three standard types of carboys. Studies have been made of gaskets, methods of closure, and the design of a new type of box to reduce breakage in transit.

The drum committee, under T. P. Callahan, of the Merrimac Chemical Company, chairman, has continued its tests on the use of new alloys and aluminum, studying not only types and materials of construction but also methods of closure, welding, etc. The committee on poisonous articles and miscellaneous packages, also under the chairmanship of Mr. Crass, has studied the question of standardizing toxicity tests, and has worked co-operatively with other agencies in the development of single-trip containers and special barrels for certain chemical products. The final meeting was that of the traffic committee, of which H. W. MacArthur, U. S. Industrial Alcohol Company, is the acting chairman. The work of this committee is also closely allied with that of other agencies of the government and railways.

Reeser Re-elected Head Of Oil Institute

AT THE annual meeting of the American Petroleum Institute held in Chicago last week, E. B. Reeser, president of the Barnsdall Corporation, was re-elected president of the institute. Other officers elected are: Robert R. Penn, vice-president for production; R. C. Holmes, vice-president for refining; and E. G. Seubert, vice-president for marketing. The following were re-elected: W. R. Boyd, Jr., executive vice-president; A. L. Beaty, treasurer; and Lacey Walker, secretary and assistant treasurer. L. P. St. Clair was re-elected vice-president at large.

Directors of the institute approved plans for mid-year meetings of the producing, refining, and marketing divisions, due to growing congestion at annual meetings.

Mechanical aspects of eliminating waste in the production of oil, together with a discussion of the unit system of controlling output, engaged the attention Wednesday of institute members.

New Ammonia Plant In Germany

A REPORT to the Department of Commerce states that Gewerkschaft Ewald, of Herten, Westphalia, has completed the second of the three synthetic ammonia units proposed to operate an American process. Each of these units is accorded a production quota within the German nitrogen syndicate of 11,250 metric tons of nitrogen annually. Thus, the oversaturated German nitrogen market admits another producer from the Ruhr district operating a hydrogen separation from coke-oven gas; the other two are the I. G. Mont-Cenis plant and the Ruhrchemie A. G. Still another, outside the nitrogen syndicate, is the Gewerkschaft Victor.

Large Number of Exhibits For Power Show

ARRANGEMENTS have been practically completed for the holding of the Ninth National Exposition of Power and Mechanical Engineering at Grand Central Palace, New York, during the week beginning Dec. 1. More than 400 exhibitors will display their products at the exposition and it is announced that a surprisingly large number of new products will be on view.

One of the most interesting of recent developments has been the stride that welding is making in the power plant field. Already buildings that were formerly riveted are silently welded. More and more welding is coming into use in power plant work. It began some years ago with the welding of the fins in connection with some types of water wall furnaces and is now expanding and interest is growing until it has been freely predicted that welding will be eventually used in all types of boiler construction. One exhibitor has arranged to show three new types of welding machines. Exhibits of machine tools will include automatons which respond in action to the pressure of a button.

Alpha Chi Sigma Members Hold Dinner

THE Alpha Chi Sigma dinner at the fall meeting of the American Chemical Society was attended by one hundred and twenty members of the fraternity. H. E. Wiedemann, consulting chemist, St. Louis, and a national vice-president of the organization, served as toastmaster. Among the various speakers were the national president, Charles A. Mann, head of the chemical engineering department, University of Minnesota; M. C. Jewett, Procter & Gamble, and secretary of the Cincinnati professional chapter; Harry A. Curtis, National Research Council and fraternity historian; Gunnar Carlson, president of Alpha Delta, the local chapter at the University of Cincinnati; E. F. Farnau, professor of chemistry, University of Cincinnati; H. B. Stevenson, Procter & Gamble, and associate editor of *The Hexagon* of Alpha Chi Sigma; and Dr. E. K. Rideal, of Oxford University, Cambridge, England.

New Research Building For M. I. T.

PLANS for a new building with unusual provisions for fundamental research and advanced instruction in physics and chemistry at the Massachusetts Institute of Technology are now being prepared, and construction will be started before winter.

Funds for starting the building, which will join two wings of the present buildings on the east side of the main technology educational group, are available from the gift of $2,500,000 donated by George Eastman in 1916.

The new structure will be over 300 ft. long, 60 ft. wide, and will contain four stories and basement. It will include a well-equipped shop for the construction and maintenance of the delicate instruments used in research, a spacious lecture room, and a joint library and reading room for the use of the staff and students in physics and chemistry.

In addition to the proposed physics and chemistry building, plans for a cryogenic laboratory for fundamental studies in the science of low temperatures are under consideration.

S. W. Stratton Heads Textile Research

AT the first annual meeting of the United States Institute for Textile Research, held in New York Nov. 6, permanent organization for fundamental research in the textile industry was effected. The institute has been functioning since July as a preliminary of 24 directors who were designated for organization work by an equal number of associations. Dr. Samuel W. Stratton has been elected president, and other officers include H. R. Fitzgerald, T. T. Clark, Albert F. Bemis, E. A. Clements, W. R. Blum, H. V. R. Scheel, vice-presidents; E. N. Hood, treasurer; and Charles H. Clark, permanent secretary.

Soap Production Increased Last Year

VALUED at factory prices, soap shipped or delivered last year by manufacturers engaged primarily in such production amounted to $258,815,408, an increase of 6.5 per cent as compared with $242,927,457 reported for 1927.

This information is contained in a preliminary report which shows that the total for 1929 is made up as follows: Hard soaps (not including granulated and powdered soaps), 2,188,613,984 lb., valued at $194,451,512; granulated and powdered soap, 288,409,786 lb., $29,219,665; soap powders (including commodities reported as cleansing powders, washing powders, etc.), 452,723,389 lb., $25,622,421; liquid soap, 20,851,475 lb., $1,522,716; soft soap, 63,741,783 lb., $3,056,078; paste soap, 41,170,425 lb., $3,127,994; special soap articles and soap stock or soap base, $1,815,022.

NEWS FROM WASHINGTON

By Paul Wooton

Washington Correspondent of Chem. & Met.

PREFERENTIAL consideration will be given by the Tariff Commission to requests from Congress for flexible tariff investigations, but this policy, according to H. P. Fletcher, the chairman, will not be carried to the point of ignoring applications that are of broad public interest filed by private parties seeking adjustment in rates of duty. The Commission recognizes that if the petitions of private industry are not acted upon, manufacturers and importers will turn to Congress with demands that the Commission be instructed to pursue investigations which they desire to have made.

In mapping out its program the Commission has given preference to investigations ordered by Congress, not only because of their large number but because most of the "spade work" in these investigations already has been completed. During the time that the tariff bill was in process of enactment the Commission did little else than compile information for the use of Congress in framing the measure. All of this data is available in carrying forward now the specific investigations in flexible tariff proceedings.

The reorganized Commission has succeeded in speeding up greatly the operation of the flexible tariff machinery in the two months that it has been in office. The cases before the Commission have been parceled out among its members and each is responsible for pressing forward as rapidly as possible those which have been assigned to him. Hearings held on ultramarine blue and several other commodities have been short and to the point. Much of the tedious delay which occurred in the past has been eliminated along with the preliminary statement of information formerly issued by the Commission.

THE hearing on ultramarine blue, Nov. 6, came up on a Senate resolution offered by Senator Copeland, of New York, acting on behalf of importers desiring a reduction in duty that on blues valued at 10 cents a pound and more was raised from 3 cents to 4 cents a pound in the new act. The importers were represented by G. M. Samuelson, foreign sales representative of Reckitts & Sons, Ltd., London; William R. Knott, manager of Reckitts, Ltd., Rochester, N. Y.; and H. G. Doggett, of Stanley Doggett, Inc., New York, importer of Reckitts' ultramarine blue.

The importers argued that the increase in duty is not justified, because imports amount to little more than 10 per cent of consumption and are not increasing, while domestic production increased and the domestic industry flourished under the old rate of duty. They informed the Commission that since 1925, the year of largest imports, the domestic price of the domestic product has declined 5 or 6 cents a pound, while the invoice value of imported ultramarine decreased by slightly more than 1 cents a pound. Mr. Samuelson stated that domestic ultramarine constantly undersells the product of Reckitts, Ltd., in this market, and, denying that his firm can dispose of low grades in foreign markets, said that two American brands of blueing undersell his brand in Central America.

Domestic manufacturers, represented at the hearing by Eugene Merz, president of Heller & Merz, Newark, N. J., and C. T. Frick, president of the Standard Ultramarine Co., Huntington, W. Va., insisted that the increased duty is not sufficient to protect them from the low-labor-cost competition of England, Belgium, France, and Germany. Declaring that imports are confined to the higher grades, Mr. Merz argued that in computing domestic costs for comparison with foreign costs, the Commission should not include the cost of byproduct blue, which is sold below cost of production. He also argued that if invoice values are taken as evidence of the cost of imported ultramarine blue, a deduction should be made for the element of profit in the absence of dumping. A fair estimate of such profit, said Mr. Merz, would be 10 per cent. The manufacturers stated that they had submitted confidential cost data to the Commission prior to the hearing.

New York was named by the manufacturers as the principal competing market, but this was disputed by the importers. Mr. Samuelson stated only one-third of the sales of his firm are made in that territory. Official records show that imports of ultramarine blue amounted in 1929 to 683,149 lb., valued at $81,282, and that imports to June 17 this year, the date the new tariff became effective, amounted to 485,529 lb., valued at $57,394. Domestic production in 1927, the latest year for which a report is available, amounted to 8,347,893 lb., valued at $1,187,035.

SEVERAL members of Commissioner Doran's advisory council met in Washington Nov. 7 to consider the recommendations made by the alcohol-using trades with reference to the revision of the regulations affecting commercial requirements. Objections submitted by the trades center principally upon provisions in the tentative draft of the regulations that, in their opinion, would tend to hamper efficient operation of their plants by imposing needlessly restrictive conditions incident to the issuance and renewal of permits. The meeting was preliminary to a final meeting of the entire membership of the advisory council on industrial alcohol to be held later in the month, and was attended by Commissioner Doran, James P. McGovern, of Washington; Harrison E. Howe, of Washington, representing the American Chemical Society; H. S. Chatfield, of New York, president of the National Oil, Paint & Varnish Association; S. C. Henry, of Chicago, secretary of the National Association of Retail Druggists; Charles L. Reese, of Wilmington; and Warren N. Watson, of Washington, representing the Manufacturing Chemists' Association.

PROTESTS having proved unavailing, the standing committee of industries which have held trade-practice conferences under the Federal Trade Commission's auspices, have selected three attorneys to appear before the Commission and specify wherein the revision made in their codes by the Commission is not required to bring them into conformity with the anti-trust laws. The hearing before the Commission probably will be held during the week of Nov. 17.

The Commission has extended the time within which industries may file objections to the changes purposed in their codes. If the Commission stands pat on the modifications tentatively adopted, the prospect is that several industries will abandon further attempts to do business with the Commission.

Louis E. Flye, Boston, general counsel of the National Plumbing and Heating Institute, Chicago; E. Barnett Prettyman, Washington, D. C., attorney; and Sol A. Herzog, New York attorney, were selected at a meeting Nov. 5 of the standing committee to present to the Commission the arguments of the Congress of Industries in opposition to the proposed revision of trade-practice conference rules. The legal battery of the Congress met Nov. 7 under the chairmanship of Abram F. Myers, former member of the Commission, to prepare for what is likely to be the final attempt to prevail upon the Commission to continue to co-operate with industry by retaining rules that are of practical value.

In accordance with a resolution adopted by the Congress of Industries at a meeting in Niagara Falls, Ont., in September, the standing committee appointed Nov. 5 a subcommittee to draft a plan for permanent organization of industries that have held trade-practice conferences. The members of this committee are Paul A. Fishback, secretary of the National Food Brokers' Association, Indianapolis, chairman; Howard P. Beckett, commissioner of the National Paper Box Manufacturers' Association, Philadelphia; and Charles J. Brand, executive secretary of the National Fertilizer Association, Washington, D. C. F. W. Swanson, commissioner of the National Plumbing and Heating Institute, the chairman of the standing committee, and Max Burger, secretary of the standing committee, are ex-officio members of the subcommittee on organization.

British Chemical Companies Show Declining Profits

Silica Gel Subject of Controversy Over Patent Rights

From Our London Correspondent

THE CHEMICAL industry is now beginning to feel the effects of the previous months of commercial and political depression and uncertainty, and if, as seems possible, there should be an upward trend in the new year, the chemical industry will be subject to a similar time lag. The annual reports of chemical concerns, including I.C.I, may therefore be of a less satisfactory nature, although dividends should not as yet be materially affected. The depression in the nitrate industry has naturally affected I.C.I. shares and the Billingham factory is hardly likely to be working at any material rate of profit. Other developments at Billingham, in regard to which an announcement may be expected in the new year, may prove to be of a most encouraging nature, and speaking generally it may be said that there is no reason to lose confidence in the present status or future progress of this British chemical organization.

Formation of a non-party "Council of Industry," consisting of business men, shows that industry has come to the conclusion that a continuance of the policy on non-interference with the politicians may be dangerous if persisted in. The chemical industry is represented by Lord Melchett and Sir Harry McGowan, of I.C.I.; Dr. Henry Dreyfus, of British Celanese; P. M. Stewart, of the Cement Company; and Mr. Robson, of Messrs. Pinchin-Johnson, the paint manufacturers.

THE history of companies established for developing new inventions or processes during the last two years has been particularly unfortunate and is generally ascribed to lack of care in seeking competent advice or making proper investigations. Many of these companies have been mentioned in these notes, and some acquired processes for which patents had not even been granted or else the patents are still in the development stage; according to the available statistics the total issued capital of 58 of these companies amounted to some seventy-five million dollars with estimated profits exceeding twenty-five million dollars.

More than half of these companies are already in liquidation or in trouble and probably 90 per cent of the capital of all of them has been lost. Obviously, the recent depression cannot be the sole cause. An interesting example is that of Brownlac, Ltd., formed to manufacture a synthetic shellac under a secret process. It was only this month that a decision was made to obtain an independent report and investigation, which resulted in a recommendation to abandon further work, and the statement that the product had little more value as a substitute for shellac than common American rosin.

Considerable interest has been shown in recent advertisements published by Silica Gel, Ltd., and the Kestner Evaporator Company, who are the agents for the Silica Gel manufactured in this country by Joseph Crosfield & Sons, Ltd., who are part of the Lever group. Silica Gel, Ltd., published a formidable list of patents, together with a warning against the unauthorized use of any of the inventions concerned. The reply was a statement that Silica Gel was manufactured in England 40 years ago by the Dee Chemical Company, which was subsequently taken over by Crosfields, and that the latter would indemnify all users against any action taken against them by Silica Gel, Ltd., in respect of the Gel manufactured and marketed by Crosfields. It seems unlikely that there will be any active conflict and probably the respective patents and methods developed by the two parties will be exploited as before and without necessarily infringing each other, particularly as there are material differences in the results obtained and methods used.

A DESCRIPTION of the new industrial solvents plant of the Distillers Company recently completed near Hull, will be found in the *Chemical Age*, London, of Sept. 27. Starting from molasses and based upon the large-scale manufacture of industrial alcohol, this factory is now producing butanol, acetic acid, and acetone as the starting point of a range of industrial solvents for present and future requirements. It is also reported that a dry-ice plant has recently been started up for testing the possible market in the shipping industry.

The rayon industry is still depressed and a number of works are closed down, while others are likely to go into liquidation. Ernest Wall, in addressing the annual meeting of the North British Artificial Silk Company, Ltd., dealt very effectively with the present position of underconsumption in Europe, and urged that propaganda on the American scale for developing the uses of rayon, might have and could still save the situation.

The "Chemistry House" project has been advanced another stage by the registration of the "Association of Scientific and Technical Institutions." A banquet is to be held at the Guildhall on Nov. 13, when the Prince of Wales will preside, and the financial and other details will be outlined. It remains to be seen whether a new building on the site provisionally reserved in Westminster will prove acceptable.

The large nitrogen producers in Europe have for some time been able to secure more favorable sales for sulphate of ammonia in large crystals, these being readily obtained when gypsum or anhydrite is used to supply the sulphuric acid radical. Others having devised means of doing this or going one better with byproduct or synthetic ammonia based on coal carbonization, it remains to be seen whether the farmers will remain faithful to the ideas inculcated by the propaganda which originated with the authors of the "Indanthrene Legend." This latter took advantage of trademark facilities to foster the idea that only those anthraquinone vat dyestuffs sold under the trade name of "Indanthren" were really fast.

The death of Lord Brotherton, this year's Messel medallist, came as a shock to his many friends and admirers, who looked forward to many years of sympathetic and constructive activity.

Important Change Made In Phosphate Tests

AMMONIATED superphosphate contains more or less apparently "available P_2O_5" according to the method of analysis used. Consequently the Association of Official Agricultural Chemists found it necessary at its meeting in Washington during October tentatively to change the "official" test procedure so that the results of analyses will conform with the practical usefulness of the phosphate as plant food.

Formerly the standard test was made with a two-gram sample to determine the available P_2O_5. That test procedure, which was developed for simple superphosphates, gives correct indications for such material, but does not indicate fully the real availability of the P_2O_5 in ammoniated superphosphate containing considerable ammonia or in other basic goods. Hence the association debated at length the extent to which the procedure should be changed in order accurately to appraise these new forms of phosphatic fertilizers.

The new test procedure tentatively adopted provides for use of a one-gram sample, digested at 65 deg. C. for one hour (formerly 30 minutes) in 100 c.c. of neutral ammonium citrate solution of standard strength. The modified procedure appears to indicate correctly the real availability as a plant food of the various types of phosphate present in the new forms of fertilizer, at least up to goods containing as much as 4 per cent nitrogen added during ammoniation. There was no provision made for further modification of the procedure for higher concentration goods, even though some persons present felt that the new procedure is not quite adequate to accommodate all such materials. The new procedure, therefore, becomes the same for all grades of ammoniated goods, regardless of the nitrogen or phosphate content.

French Naval Stores Industry Asks Government Protection

Competition of Mineral Spirits Affects Sales of Turpentine

From Our Paris Correspondent

ALTHOUGH France's financial situation is excellent, the French stock exchange is dull and most industrial shares have declined, chemical trade shares, for instance, being 40 per cent lower in 1930 than in 1929. It also appears that when the franc was stabilized in France years ago at one-fifth of its prewar value, the shares of some industrial concerns receded in value drastically, the result being that today some of them are even below their real worth.

The economic situation of other European countries also influences the French market; in 1930 French imports have been 10 per cent lower than in 1929 and French exports 12 per cent lower, making a total difference of nine billion francs for the first nine months of 1930.

There are no unemployed in France, in spite of the general slump in business; foreign labor is even extensively used in the mining, metallurgical, and chemical industries. While all French industries are operating, some of them do so only to keep up stocks and prevent the emigration of skilled labor, as in the textile industry, for instance.

On the other hand, money is no longer scarce and financial support is easily found. Industrial concerns instead of paying 6 per cent and even 7 per cent interest on capital invested, now pay 4½ per cent. Big firms thus realize a notable economy, which partly compensates for the present decrease in profits due to the general uneasiness in business.

WE think it pertinent to mention the strenuous efforts made by the League of Nations at Geneva to stop the present inter-European tariff war. A truce is contemplated, but unfortunately it seems that this truce will not be effected, as all nations have become ultra-protectionists since the war in order to protect some of their new home industries; the coloring matters industry, for instance. Some of these war-born industries thrive only because prohibitive custom tariffs protect them and special agreements are drawn between home producers and home consumers.

Recently prohibitive taxes on foreign wines were established in France in order to protect French wine growers. Spain, one of the main shippers of foreign wines into France, retaliated by taking drastic measures against all imported manufactured French goods—especially tires, motor cars and chemical products. A Franco-Spanish agreement has been made in order to stop this tariff war between the two countries.

A general European custom tariff truce is undoubtedly advisable, but it seems practically impossible to realize without injuring private interests. On the other hand, the sales prices of agricultural products are far too irregular to be adequately protected. The following instance is a striking example: In 1929 the grape gathering in France was superabundant and wine became far too cheap to be remunerative. Wine growers who have influential representatives in the Chamber of Deputies asked governmental help. At their instance four million hectolitres of wine were bought by the state for distillation purposes. (It should be remembered that in France all imported petrol must be diluted with 10 per cent of pure French industrial alcohol, a somewhat drastic measure, which, however, makes all motor car owners give an unwilling but helpful hand to French farmers.)

Since the purchase of wine by the state another grape gathering has been made in France—a most unsatisfactory one, as the weather was very unfavorable last summer. The prices of wine went up suddenly, and today wine growers find the state's help most expensive, as they would certainly sell at a far more remunerative price to wine merchants.

THE wine growers' call for governmental assistance is not the only one of its kind, rosin gathering foresters of the Landes districts also having asked official help against white spirit importers. White spirit is a cheap substitute for turpentine, hence the claims of the rosin-producing districts. Moreover, the Landes foresters not only ask for higher custom duties on all imported white spirits but they also ask that turpentine should be exclusively used in all governmental buildings and workshops.

Last summer being a very rainy one French vineyards suffered from mildew and black rot, though this was partly offset by repeated sprinkling of sulphate of copper (in 1930 up to seven sprinklings were made). Two chemical engineers, Messrs. Truffaut and Pastak recommended the use of special coloring matters with a diluting and pulverizing agent. The results obtained, it appears, have not reached all expectations and the usual sprinkling of vineyards with sulphate of copper is still preferred. More favorable results, however, have been obtained on other plants. Malachite green and brilliant green prove efficient against Penicilium glaucum and trypaflavine destroys mildew. As may be seen, the solution of this problem is not easy, as the price of coloring matters remains high while mineral products such as sulphate of copper and sulphur are cheap.

Solvents Discussed by Health Association

AT THE annual meeting of the American Public Health Association, held at Fort Worth, Texas, during the closing week of October, the committee on volatile solvents submitted a report on the health hazards presented in the use of these materials. This committee made its first report at the 1928 meeting. It has worked under the chairmanship of Dr. Elizabeth B. Bricker, chief of Hygiene and Sanitation Section, Department of Labor and Industry, Harrisburg, Pa. The purpose of this committee is to study the toxic qualities of new solvents and to record developments in the use of the older solvents.

The newer solvents discussed in the current report included ethylene dichloride, ethyl benzene, cellosolve, and dioxan. The report stated that no case records have been found in the literature describing the effects of these compounds on the workers handling them.

Among the older solvents touched on in the report were: acetone, benzine, carbon disulphide, chlor compounds, diacetone alcohol, furfural, and benzol.

Considerable attention also was given to methanol, because of increased production and lowering of prices. The report stated: "There are said to be three great advantages possessed by synthetic methanol as compared with denatured alcohol: it has a pleasant odor, since no ill smelling denaturants have been added to it; it is not hedged about by legal restrictions; and it is cheap. To the industrial toxicologist these are, of course, all serious disadvantages, and to them must be added the use of the term 'Methanol,' which is quite unfamiliar to the ordinary man, while the old terms 'wood' and 'methyl' alcohol are associated in his mind with danger."

Dr. Taylor Will Address New Jersey Chemists

THE North Jersey section of the American Chemical Society will meet at the Hotel Winfield Scott, Elizabeth, N. J., at 2 p.m. Saturday, Dec. 13. Dr. Hugh S. Taylor will address the section on "Catalytic Reactions in Aliphatic Organic Chemistry." At the conclusion of the address buses will take members to the Bayway Refinery, where they will visit the technical service, research, and motor laboratories. They will then return to the hotel, where an informal dinner will be served at 6:30 p.m. Two addresses will follow the dinner, the first by Warren K. Lewis, on the "Thermal Properties of the Higher Hydrocarbons," and the second by R. P. Russell, on "Hydrogenation of Oils."

German Chemical Industry Reflects General Depression

Unemployment Increased Recently Among Organized Chemical Labor

From Our Berlin Correspondent

NO REPORT on German industry would be complete at the present time without attention to and information on the general economic depression, with its several exceptions. An indication of this condition is the large increase in curtailed working hours. In September, 16.5 per cent of the organized chemical labor was completely unemployed and 19 per cent worked on reduced schedules. At the same time in the prior year only 6.4 per cent were completely unemployed, while only 5.8 per cent had reduced hours. This increase has been particularly great in the last few months; at the beginning of August the curtailed employment was only 13.9 per cent, against 19 per cent a month later. The economic strain has been aggravated by the large metal workers' strike, which involved 126,000 workers and the ultimate effects of which cannot yet be calculated.

The difficulties of the metal industry were emphasized by F. Warlimont, Hamburg, at a recent session of German mining engineers. The low price of metals is a particular handicap to companies with their own mines, but the companies working on loaned mines also are suffering severely. The zinc smelters are hard pressed by foreign competition, such as Belgium and France, where labor and other costs are much lower. The waste and tailings in copper refining also cannot be satisfactorily exploited. Aluminum alone has been spared a reduction in price, thanks to the European aluminum cartel, although sales difficulties are beginning to assume dangerous proportions.

Coking had to be somewhat curtailed in western Germany because of the tar market; briquetting caused a slight improvement in tar consumption this fall, but the weather has reduced the road tar consumption. Foreign bitumen processed in great quantities in German factories offers strong competition to the domestic product. The only German source of natural gas, in Neuengamme near Hamburg, is slowly nearing the point of exhaustion now, after 20 years of activity. During the last year it yielded only 276 cu.m.

MEANWHILE a substantial increase in petroleum production continued throughout August, giving a total of 14,210 tons for that month against 11,800 in the previous month and 8,600 as an average for 1929. Furthermore, the Elwerath Company near Hanover drilled into a very considerable deposit on its property at Nienhagen on Sept. 19. The gusher is so strong that even the best technical equipment does not prevent some 300 tons of oil from escaping daily. This is a production that has never been approached before in Germany.

The hydrogenation plant of the Duisburg coal liquefaction concern, the only one that treats coal by the Bergius process, was recently shut down. The results of the last operating period are going to be studied, but certain changes of a technical nature are also to be undertaken. The reason is that in spite of the use of high-grade materials of construction, some of the parts subjected to high pressure showed very great wear and make the present arrangement unsatisfactory. Therefore, it is not likely that quantity production will be undertaken in this type of hydrogenation in the near future. Difficulty with materials of construction has also caused the I. G. Farbenindustrie to confine its pressure hydrogenation to tars and oils.

ACCORDING to a report of the I. G., the situation from the second to the third quarter has in general remained unchanged. The sales of alkali and solvents remain weak, but pharmaceuticals are doing well and export to several countries has increased. The mutual work of the I. G. and the Standard Oil Company of New Jersey, through the Hydro Patents Company, has been licensed to all large oil producers, and the beginning of operations at Bayway on Aug. 7 is also announced. Recently several Japanese refineries have also entertained the possibility of introducing the hydrogenation process.

Since quartz tubing and pipe are being increasingly used for technical purposes, it is interesting to note that the German-English Quartzschmelze G.m.b.H., Berlin, has developed a process for making thin tubes in any desirable lengths according to industrial needs. A new safety glass, Luglas, has been put on the market by the Röhm & Haas Company, Darmstadt. Luglas is composed of two glass plates and a sheet of synthetic material called "Flexigum." It is claimed to possess all the desirable properties such as durability, light-fastness, increased impact strength, increased resistance to heat, easy cutting, and so on.

Soil Scientists to Meet In Washington

SOIL scientists and agronomists from all parts of the United States and from Canada will attend the meetings of the American Soil Survey Association and the American Society of Agronomy at the Raleigh Hotel in Washington, Nov. 18-21.

Progress in soil surveys and methods of mapping and classifying soils will be discussed by soil experts of the U. S. Department of Agriculture and the states now actively engaged in taking inventory of their soil resources.

Dr. Curtis F. Marbut, chief of Soil Survey of the Bureau of Chemistry and Soils, will discuss the International Soil Congress which he attended while in Europe this summer. Other features of the two-day meeting of the American Soil Survey Association, Nov. 18 and 19, will include discussions of organic and forest soils, soil structure, soil acidity, soil colloids, and the technique of soil mapping and of making reports of soil surveys.

Problems of soil improvement, crop rotations, fertilizing, and other practical and technical problems dealing with agricultural land, will be discussed at the two-day session of the American Society of Agronomy on Nov. 20 and 21.

Belgium Abandons Mouth-Blown Glass

MOUTH-BLOWN glass, traditional manufacture of many centuries in Belgium, has been abandoned completely in favor of the machine-blown article with the recent shutting down of the last tank in the country engaged in this type of production, according to a report received in the Department of Commerce.

As regards mechanically drawn window glass, employers and workmen have come to an understanding in the form of a reduction of 5 per cent in wages, with the result that the Concentration des Verreries Fourcault immediately reopened two tanks.

Fourcault and American controlled interests, it is reported, have entered agreements covering prices and production, which will be based on two-thirds for the former factories and one-third, or 30 per cent, for the latter. Every step necessary as regards price concessions probably will be taken in an effort to recover foreign markets. Projects are under consideration for the installation of new equipment in the mills with a view to lowering manufacturing costs and providing for the utilization of gas from coke ovens and blast furnaces.

Survey on Consumption Of Chemicals

THE industrial development department of the Commonwealth & Southern Corporation recently completed a survey on the consumption of chemicals in Alabama, Georgia, and Tennessee for the calendar year 1928. The survey gives detailed statistics for consumption in each of these states of more than seventy of the more important chemicals. Copies of this study will be furnished to interested parties.

Outstanding Leaders Who Have

The Scene

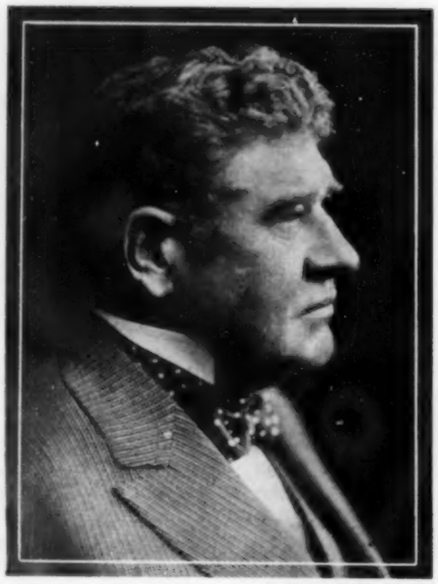
ELLWOOD HENDRICK

Ellwood Hendrick, curator of the Chandler Chemical Museum of Columbia University and unique spirit, who graced many fields of interest, died on Oct. 29, at his home in New York, from pneumonia contracted shortly before. He was in his 69th year and had recently returned from Europe. In *Chem. & Met.'s* memory his five years of consulting editorship and daily association represent a particularly happy period. How the world at large esteemed him will be seen in the citations following this brief outline of his career. Born in Albany in 1861, he went abroad to receive his education at the University of Zürich and returned to his native city to become manager of a chemical works there for four years. For some 20 years afterward, however, he devoted himself to business and stock brokerage in New York before he returned to his early interest, chemistry, in the establishment of Arthur D. Little, Inc., at Cambridge, Mass. His talent for educational writing was fostered there and meanwhile it further expressed itself in the form of several of his published books. His connection with *Chem. & Met.* lasted from 1918 to 1923 and in 1924 he was appointed curator of the Chandler Museum. Recognition of his gifted personality came to him repeatedly from different societies as well as in the hearty reception of his books, among which the best known are: "Everyman's Chemistry," 1917; "Percolator Papers," 1919; and "Modern Views of Physical Science," 1925.

"Ellwood Hendrick's great service to chemistry was as interpreter of the science to the man in the street, but all who were privileged to come in contact with him will cherish his memory still more dearly because of his wonderful capacity for friendship and the stimulus of his contagious enthusiasm."

Arthur D. Little

"Lafcadio Hearn, in his self-exile in the Orient, writing to Ellwood Hendrick when other correspondents had dropped away, said that he did not know what to do 'without the occasional wind of sympathy' wherewith the letters of this chemist friend refreshed him. When one has read a letter from Dr. Hendrick one can understand why Lafcadio Hearn wrote so many letters to him—just to get the 'wonderful' replies, full of 'penetrating things,' of 'witty flashes and curious observations.' It is to be hoped that they have not generally suffered the fate to which Hearn consigned some of those he received—since they contained personal portraits which made it his duty to burn them. He had difficulty in doing so, as he said, for it was a destruction of the artistic.



Underwood & Underwood

"Fortunately, there is a little collection of essays, 'The Percolator Papers,' in which the rare quality of this humanistic industrial chemist is revealed. In one of them he says that the language of science is definite, distinct, mathematical, and 'unconscionably ugly.' But his talent was as a catalyst which transformed what it touched and made of that language human, living speech. Hearn was ever urging him to preserve his thoughts in writing, saying that they would self-arrange themselves 'kaleidoscopically' and would try to live; that he had but to breathe into their nostrils and be 'astonished and pleased.' Happily, Hendrick had that experience along with the rewards that came to him in his profession. In Leonardo's time a master was 'an artist because he was an engineer.' This master of chemistry had that which gave artistic value to all the scientific material he gathered.

"He constantly urged that the man of research must set forth his findings in terms that will be understood. Otherwise he is more reprehensible than a miser, 'for the miser cannot carry his treasure with him when he dies,' whereas the man of research can do what amounts to that. Dr. Hendrick's own chief service, as one in whom dwelt both scientist and artist, was to help the man of research to do what often he could not do for himself—share the treasures of his discovery with mankind. To transcribe what some unknown one said of a certain ancient Chinese artist, he used his inks as the Lord the waters.

"He once said, after speaking of Tyndall and Huxley and Duncan, that there was no one left who had the mastery of the art to write of science. If there were and are others, their number is now less by one."

New York Times
Oct. 31, 1930

Peirce D. Schenck, president of the Duriron Company, Dayton, Ohio, since its inception 15 years ago, died suddenly on Oct. 15, ending a long career in the metals industry. Soon after receiving a technical education at Yale University, Mr. Schenck worked his way to the presidency of the Dayton Malleable Iron Company and there conceived the ideas leading to the development of acid-resistant alloys, which were later to materialize on the formation of the Duriron Company, Dayton.

Sidney M. Colgate, chairman of the board of the Colgate-Palmolive-Peet Soap Company, died suddenly on Nov. 10 at his home in Orange, N. J., after a short illness at 68 years of age. Born in Orange, Mr. Colgate was sent for his education to Yale University and entered the soap business started by his family on finishing college in 1885.

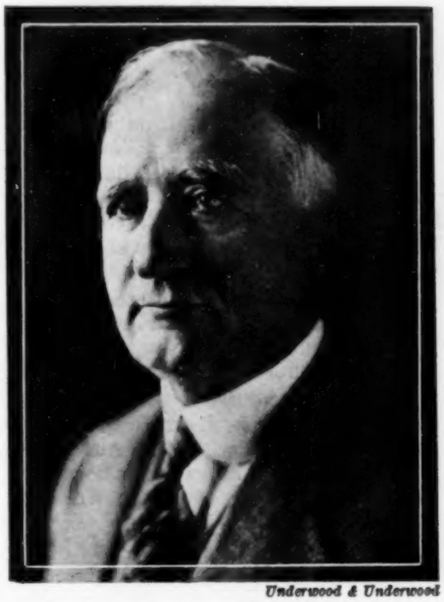
Carl F. Bierbauer, superintendent of the Hercules (Calif.) explosives plant of the Hercules Powder Company, died suddenly on Oct. 28 of heart disease, at the age of 51. After joining the Hercules organization in 1915, he became the first director of its experimental station at Kenvil, N. J., in 1917. In 1922, he was transferred to Hercules, Calif., where he was made superintendent in 1929.

Kenneth M. Baum, vice-president in charge of production of the Arizona Minerals Corporation, at Yuma, died of heart failure in Los Angeles, on Oct. 19, at the age of 49. Raised in New Hampshire, he was graduated from Massachusetts Institute of Technology as a chemical engineer, and subsequently had a wide experience as engineer throughout the country. His principal work was expended on copper and lead smelting, sulphur mining and refining, and water softening. For the past two years he was engaged in the production of synthetic zeolite, developing the plant of the Arizona Minerals Corporation.

Passed From of American Chemistry

HERBERT H. DOW

An appreciation of the career of Herbert H. Dow, whose death was reported in these columns last month, is offered below by two of his former associates. Dr. Dow was born in Ontario in 1866 during a temporary sojourn of his parents in Canada. They soon returned to Birmingham, Conn., however, and there Dr. Dow spent his early youth. At 12, he accompanied his family to Cleveland and later was graduated from the Case School of Applied Science there in 1888. After a short career in teaching, he organized the Midland Chemical Company and Dow Process Company, which eventually formed the Dow Chemical Company. This enterprise thereafter served as vehicle for his vast scope of ideas and energy.



Underwood & Underwood

"Herbert Dow was scientist and manufacturer, characterized by a creative, prophetic vision which encompassed not only the fields of the chemical and mechanical arts, the principles of manufacturing and merchandising, but the realm of fine arts as well. Even casual conversation with him brought a rapid fire of questions, suggestions, and speculation on many different topics and through highly unusual avenues of approach. Coexistent with his great imaginative power there was a well-balanced knowledge of general science, an intimate familiarity with the latest commercial developments, a clear insight into the practical significance of natural laws; all these combined with a broad and wise business sense. He seemed to possess an inexhaustible supply of energy, and was never idle from early morning till late at night. ~~To him the word impossible was a direct challenge to immediate action.~~ Exceedingly democratic by nature, he always took a particular and most substantial interest in the general welfare of his home town and its people. A perfectly unique and beautifully designed courthouse replaces a relic of the lumber days because of his artistic interest and financial support. He was a powerful influence in spreading a practical appreciation of aesthetic value throughout the whole community.

"A gentleman, generous to a fault, interested in everybody but never paternalistic, honored and beloved by his whole community and a host of friends all over the world, some of high degree and some of low, such a man was Herbert Henry Dow."

W. R. Veazey,
Professor of Chemical Engineering
Case School of Applied Science
Cleveland, Ohio

"One of the most interesting things about Dr. Dow's work has been the originality of the processes and of the methods of carrying them into execution. When he began chemical operations at Midland he embarked upon a process of his own invention with no expert assistance and in a location which was literally in the backwoods of Michigan. This isolation made it incumbent upon the company to install and maintain larger repair shops than would otherwise have been necessary, and these larger shops in turn stimulated Dr. Dow and the engineers whom he gathered around him to design and build more and more of their own equipment. This might have been fatal with a less brilliant leader; the final result was the development of a unique plant. Sulphuric acid is traditionally the backbone of the heavy chemical industry, yet the Dow Chemical Company furnishes an illustration of such a plant which does not make or buy any sulphuric acid.

"The location of the plant was determined by the presence of an impure brine especially high in bromine, for bromides were the initial product of the plant, but the field of operations were gradually extended to include the utilization of all of the other constituents of the impure brine and the conversion of this unpromising raw material into the source of not only chlorine, bromine, and caustic soda but also calcium chloride, magnesium sulphate, metallic magnesium, and many other inorganic products. Since there was little profit in selling bleaching powder and caustic soda, Dr. Dow turned his attention to the manufacture of organic chemicals and developed the manufacture of indigo and other dyes as well as new and extremely useful methods for the manufacture of phenol and aniline.

"His father was an ingenious mechanical engineer and the son learned from the father the principles of mechanical engineering and a fondness for thermodynamics which stood him in good stead when he was thrown upon his own feet. He could not only pass judgment on the chemical possibilities of a process but also on the equipment in which it was to be made, the methods of fabrication of that equipment, and the most economical way of supplying the needed energy to the process.

"As the plant grew, Dr. Dow surrounded himself with many trained assistants. He took pride in the fact that most of them had come to him as young men and had developed within the plant. Many of these young men have become responsible heads of divisions, and have contributed much to the reputation and success of the Dow Chemical Company. Dr. Dow has left not only a plant but also an organization abundantly able to continue and further develop its operations. It is, however, no discredit to this vigorous group to say that up till his last illness, Dr. Dow was still the moving spirit and the guiding genius of the great organization which bears his name."

Alfred H. White,
Professor Chemical Engineering
University of Michigan

T. Coleman duPont, former president of E. I. duPont de Nemours Company, died at his home in Wilmington, Del., on Nov. 11, in his 67th year. In a long and many-sided career, General duPont served as executive and organizer of many industries in addition to that associated with his family, and was at one time Senator from Delaware. He was a grandson of the founder of the company and a cousin of Pierre, Lammot, Irenee, and Alfred I. duPont.

Addison W. Beale, president of the A. M. Byers Company, Pittsburgh, Pa., which has adopted the new Aston process for wrought iron, died on Oct. 28.

Edward Beck, secretary and manager of the Canadian Pulp and Paper Association, died on Oct. 23 in his 64th year. Although a native of England, Mr. Beck was long engaged in newspaper work here and in Canada, and assumed his association post in 1921.

MEN

IN CHEMICAL ENGINEERING

F. G. Cottrell has resigned as director of the Fixed Nitrogen Research Laboratory and assumes a consulting relation to that division of the Bureau of Chemistry and Soils. Dr. Cottrell is to devote a substantial part of his time to other investigations, including work in co-operation with the Smithsonian Institution.

Chemical engineering and yachting prove an interesting combination in the experience of Henry Howard, consulting engineer, recently returned from Europe. He sailed on the "Leviathan" last August to navigate a yacht in the race from Plymouth, England, to Santander, Spain. While in England he

J. V. N. DORR H. HOWARD

discusses the Battle of Jutland with the British navigator of the fleet, and later, in Berlin, dined with the German admiral who had opposed the English on that historic occasion. In Spain, Mr. Howard was the guest of the King on his yacht at the local races, and later in Holland he not only saw the Dutch races but, at the invitation of the ex-Kaiser, spent an hour with him at Doorn. Conferences with Dr. Carl Duisburg, of the I. G. and other chemical industrialists, attendance at the International Union of Pure and Applied Chemistry at Liége, and independent chemical engineering investigations for at least two clients, rounded out this eventful experience. In the accompanying picture, taken in front of the old Town Hall at Aachen in September, Mr. Howard is shown with John V. N. Dorr, president of the Dorr Company, and his companion in his travels in Germany.

Arthur D. Little, president of Arthur D. Little, Inc., Cambridge, and an outstanding figure in the development of chemical engineering industry, has been elected to receive the Perkin Medal for 1931 by the American Section of the Society of Chemical Industry.

Theodore M. Switz, has left the Investment Research Corporation, Detroit, to become technical adviser and research economist on chemicals for the Lehman Corporation, New York.

R. B. Stringfield, formerly chief chemist for the Goodyear Rubber Company at Los Angeles, has recently taken part in the organization of a new firm, Stringfield & Oedekerk, for work on plastics technology.

Atherton Hastings, formerly of the Atmospheric Nitrogen Corporation, Syracuse, has joined the Du Pont Ammonia Company, Belle, W. Va.

Vladimir V. De Sveshnikoff, consulting chemical and metallurgical engineer, has been appointed research associate to the National Bureau of Standards, Washington.

I. H. Andrews, research chemist with the Powell River Company, pulp and paper manufacturer of Powell River, B. C., has been elected vice-president of the Technical Association of the Pulp and Paper Industry.

Roger W. Richardson has joined the technical department staff of the Du Pont Ammonia Corporation at the Belle (W. Va.) works. Dr. Richardson is a graduate of the Iowa State University, and until recently was employed by the U. S. Bureau of Standards.

CALENDAR

American Institute of Chemical Engineers, New Orleans, Dec. 8-10.

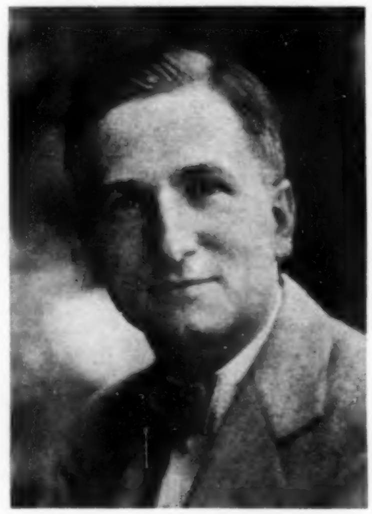
American Chemical Society, 81st meeting, Indianapolis, March 30-April 3, 1931.

Electrochemical Society, spring meeting, Birmingham, Ala., April 23-25, 1931.

Technical Association of the Pulp and Paper Industry, annual meeting, New York, Feb. 16-19, 1931.

National Exposition of Power and Mechanical Engineering, New York, Dec. 1-6.

Willard H. Dow, formerly assistant general manager of the Dow Chemical Company, Midland, Mich., has been elected president and general manager of the organization to fill the place left vacant by the recent death of his father, Herbert H. Dow. Although only 33 years of age at the time, his election was foreseen because of his long interest in chemical manufacture and complete familiarity with the company's technical affairs. A graduate from high school in 1914, he interrupted his education with a year's work at the Dow plant and then entered the University of Michigan to receive his degree in chemical engineering four years later. It was in 1919 that he began the activity in various parts of the Dow Chemical Company which made him a member of the board in 1921 and brought him the



position of assistant general manager in 1926. Since that time his executive duties have constantly increased and on his present election a vote of confidence from the directors escorted him into his new career.

Frank C. Yokel has resigned as chemical engineer with the Stauffer Chemical Company, to become chief chemist with the Los Angeles Chemical Company.

Everett Chapman, formerly director of research for the Lincoln Electric Company, Cleveland, has been appointed to the position of director of development and research for the Welding Division of Lukens Steel Company, Coatesville, Pa.

Allan L. Tarr, formerly on the teaching staff at the Massachusetts Institute of Technology, has resigned from the General Electric Company to become instructor in metallurgy in Cooper Union, New York.

John W. Boyer, has resigned from his post of vice-president of the Monsanto Chemical Works, St. Louis.

John R. Huffman has joined the staff of the Standard Oil Development Company, Elizabeth, N. J., after completing graduate work at Yale and the University of Copenhagen.

MARKET APPRAISAL OF CHEMICAL INDUSTRY

REPORT of Spencer Kellogg & Sons, Inc., and subsidiaries for 11 months ended Aug. 30, 1930, shows net profit of $636,614 after depreciation, interest, and federal taxes, equivalent to $1.16 a share on 550,000 no-par shares of common stock. In the fiscal year ended Sept. 28, 1929, the company reported net profit of $1,297,-730, equal to $2.36 a share on common. Company has changed its fiscal year to end Aug. 30.

•

American Glue Company has called for redemption on Jan. 1, 1931, its entire outstanding issue of serial 5½ per cent notes, amounting to $1,310,000. Notes will be redeemed according to maturity dates at prices ranging from 100-103½ plus accrued interest.

•

Sherwin-Williams Company had net earnings of $3,551,294 for its fiscal year ended Aug. 31. This compared with net earnings of $6,019,004 for the preceding year, which, however, included a special refund of federal taxes and other non-recurrent items.

•

Voting trust agreement of Columbian Carbon Company has been extended from Nov. 1 this year until Nov. 1, 1935. Holders of voting trust certificates representing 270,160 shares of the no-par capital stock, of which 2,000,000 shares are authorized and 498,505 are outstanding, consented to the extension.

•

Issuance by Atlas Powder Company of an additional 6,318 shares of 6 per cent cumulative preferred stock and 3,861 shares of no-par common stock represents part consideration for an interest in Peerless-Union Explosives Corporation. For these shares, Atlas will acquire 21,732 shares of 6 per cent cumulative preferred stock and 32,198 common shares of Peerless-Union.

•

The Devoe & Raynolds Company has invited tenders of the company's first preferred stock to exhaust the sum of $38,802. The shares, which will be purchased for the sinking fund, may be tendered until Nov. 20 at the Chase National Bank, New York City.

•

Archer-Daniels-Midland Company, Minneapolis, has reported a consolidated net income for the year ended Aug. 31 totaling $1,375,761 after depreciation and taxes, which was equal to $2.01 a common share, after preferred dividends. This compared with a net of $1,453,408, or $2.45 a common share, reported for the preceding fiscal year.

•

Net incomes of companies in the chemical and related fields, for the first three quarters of this year and comparisons with the corresponding period of 1929, are as follows:

	Nine Months 1930	Nine Months 1929
Air Reduction	$4,148,202	$4,292,956
American Metal	1,629,926	2,566,126
Atlas Powder	1,075,099	2,049,056
Bon Ami	1,044,507	1,126,414
Commercial Solvents	2,684,951	3,808,221
Consolidated Chemical	513,526	454,754
Corn Products	10,170,342	10,869,182
Du Pont	41,505,674	57,215,662
Hercules Powder	2,160,260	3,236,190
Houston Oil	1,307,043	1,252,630
Mathieson Alkali	1,597,462	1,726,904
Monsanto Chemical	795,912	....
National Distiller	344,655	462,845
Texas Gulf Sulphur	10,793,799	11,480,489
Union Carbide	7,208,679	9,522,421
United Carbon	676,443	1,079,186

Price Range 1930 High	Price Range 1930 Low	Stock	Price Range in October Oct. 1	High	Low	Oct. 31
34	16	Agfa Ansco Corp	....	....	....	....
156⅞	96⅞	Air Reduction	110½	114¼	96⅞	100½
2½	⅜	Ajax Rubber	1⅛	1⅛	⅛	⅜
343	194	Allied Chemical	242	243	194	196⅝
356	150	Aluminum Co. of America	....	192	150	....
10⅞	2	Am. Ag. Chemical	3	3½	2½	2½
33	9½	Am. Commercial Alcohol	15	15⅝	11	13
37	10	American Cyanamid, B	13¾	13¾	10	11
7	2½	American Hide & Leather	....	3¼	2⅜	....
51½	18⅜	American Metals	22½	23¼	18⅜	20⅝
22½	3⅜	Am. Solvents & Chemical	....	5¾	3⅛	4⅝
43⅞	14¼	Anglo-Chile Nitrate	20⅛	23	14¼	20
29¼	17½	Archer-Daniels-Midland	19¾	20⅞	17½	....
8⅞	3½	Armour, Ill., A	4½	4⅝	3½	3⅝
51⅞	21⅜	Atlantic Refining	27⅝	29½	21⅜	22
106	54	Atlas Powder	65	67¾	54	58
70⅜	48	Beechnut Packing	52⅞	53½	48	62
5¾	1⅞	British Celanese	1⅞	2⅜	1⅞	....
35	22	California Petroleum	....	22	22	....
20	12	Celluloid Corp	....	16⅞	13	....
15⅞	4	Certain-teed	5⅛	5¼	4	4½
32½	15⅜	Chickasha Cotton Oil	16	16	15⅛	15⅝
64¾	49	Colgate-Palmolive-Peet	55¾	55¾	49	51⅝
199	84¾	Columbian Carbon	118¾	119¾	84¾	88⅞
38	17⅞	Commercial Solvents	22	23	17⅞	17½
111⅞	74½	Corn Products	82⅞	83¾	74½	74⅛
43⅞	18	Davison Chemical	21½	23¼	18	18⅛
42¾	18	Devoe & Raynolds A	19	20⅜	18	....
100	49	Dow Chemical	63	66⅞	49	....
145¼	88⅞	Du Pont	108	109	88⅞	89¾
123	114½	Du Pont, 6 pc. deb	....	123	118¾	118⅞
21	2	Duval Texas Sulphur	4¾	4¾	2	2½
255¼	168⅞	Eastman Kodak	203⅞	207	168½	171⅞
33⅜	15⅞	Firestone Tire	18	18⅞	15⅞	18⅞
5½	1	Fisk Rubber	1½	1½	1	1
55⅛	31¾	Freeport Texas	40⅜	42⅜	31¾	33⅜
71⅜	28¾	General Asphalt	36¾	37½	28¾	28⅞
38	10⅝	Glidden	14⅞	14½	10⅜	10¾
47⅞	31	Gold Dust	37¾	38½	31	33½
58½	15¼	Goodrich Co	20½	21	15¼	17
85	60	Hercules Powder	....	67½	60	....
23	11¾	Heyden Chemical	....	13	12⅜	....
7	4⅛	Imperial Chemical Ind	....	4¾	4⅛	....
124	31	Industrial Rayon	....	78	31	....
8½	3⅝	Int. Ag. Chemical	3⅞	4¾	3⅝	....
44⅞	16½	International Nickel	21¾	22⅝	16½	17¾
31⅜	8	International Paper A	13⅝	14	8	9⅝
45¾	31	International Salt	37	38½	31	....
25	12	Kellogg, Spencer & Sons	....	14¼	12	....
6⅛	1⅞	Kelly-Springfield	2⅜	2⅜	2	....
11	3½	Lee Rubber & Tire	4	4	½	43
36	21	Lehn & Fink	23¾	27½	21	27
31½	11	Libby-Owens	17	17¾	11	11⅞
81⅜	45⅛	Liquid Carbonic	61	63	45⅛	48
37⅞	10⅞	McKesson & Robbins	14½	15¾	10⅞	12¾
51⅞	32⅞	Mathieson Alkali	37⅞	38¼	33¾	34
63¾	23	Monsanto Chemical	32¾	33⅞	23	26
39⅜	22¾	Nat'l Distillers Products	28⅜	29¾	22⅜	23¾
189½	116½	National Lead	....	123	116½	120
91½	48	New Jersey Zinc	....	64	48	54
42	16½	Newport Co	20	20	16½	18
32	20⅜	Ohio Oil	26	26¾	20⅜	20⅞
60⅞	36½	Owens-Ill. Glass	40⅜	41	36⅛	37⅞
44¾	20⅜	Phillips Petroleum	26⅜	27⅜	20⅜	22¾
59¾	40	Pittsburgh Plate Glass	....	40¾	40	....
57⅜	36	Pratt & Lambert	....	41⅜	36	....
78⅞	52⅜	Procter & Gamble	70	70⅞	66	66½
27¾	10¾	Pure Oil	18⅞	18⅜	10¾	12¾
85	74	Sherwin-Williams	....	75	75	....
34½	10⅛	Silica-Gel	12	13½	10⅛	11¾
32	13	Sinclair Oil	17⅞	18⅛	13	14
42	17¾	Skelly Oil	24⅞	24½	17¾	18
75	51	Standard Oil, Cal	57½	57¾	51	51
84¾	52	Standard Oil, N. J	60⅞	62⅞	52	52⅞
40⅞	25½	Standard Oil, N. Y	28½	29⅞	25½	26⅞
70	50	Sun Oil	55	56½	51¾	....
10	4	Swan & Finch	....	4	4	....
34½	28	Swift & Co	28⅜	29¼	28⅛	28⅞
17	8¼	Tennessee Copper & Chemical	9	10	8¼	9½
60½	38⅞	Texas Corporation	46½	47	38⅞	40⅜
67⅞	48½	Texas Gulf Sulphur	55⅞	56⅞	50⅛	52
17¾	9¾	Tidewater Assoc. Oil	10⅜	11⅛	9¾	10
22¾	3⅜	Tubize Chatillon B	5½	5½	3⅜	4⅜
106⅞	59	Union Carbide	70⅜	71⅞	59	60½
50	28	Union Oil, Cal	35¼	36	28	28
84	28½	United Carbon	41½	42¾	28⅞	29¾
139⅞	58¼	U. S. Industrial Alcohol	63	68⅜	58¼	63½
15½	6	U. S. Leather	7½	8⅜	6	....
35	11	U. S. Rubber	15½	17	11	13
97⅞	59⅜	Vacuum Oil	72¼	73	59⅜	61½
143¾	46⅞	Vanadium Corp	61¾	64⅞	46⅞	48¼
8¾	2½	Va-Car. Chemical	3	3¼	2½	2⅝
29⅜	22	Wesson Oil	24¼	25⅜	22	24⅜
59½	27½	Westvaco Chlorine	32¼	34½	27½	....
7¾	2½	Wilson & Co	....	3⅜	2½	....

ECONOMIC INFLUENCES

on production and consumption of CHEMICALS

Production of Chemicals Holding On Level Keel

Current Operations Maintain Rate Established in Preceding Month

AMERICAN manufactures reached the highest point in production in 1929 of any year in history according to a report released on Nov. 7 by the Department of Commerce. The value of manufactured goods for that year was approximately $68,000,000,000. The high rate of activity maintained over the greater part of last year has accentuated the slower progress made this year and perhaps has overemphasized the industrial decline this year, because of comparisons made with an abnormal preceding year.

Since the close of the warm weather period there has been an appreciable gain in production of chemicals and the position of consuming industries has been improved to a point where they were able to absorb the increased output of raw materials.

Activities in some of the important producing and consuming branches of the chemical industry for September, with comparisons for last year, are shown as follows:

Production	**Sept., 1930**	**Sept., 1929**
Acetate of lime, 1,000 lb	4,955	10,154
Methanol, crude, gal	289,765	598,548
Methanol, refined, gal	201,663	432,094
Alcohol, ethyl, 1,000 pr. gal	14,299	20,739
Alcohol, ethyl, withdrawn for denaturing, 1,000 pr. gal	12,615	19,199
Arsenic, crude, ton	2,077	1,027
Arsenic, refined, ton	1,101	868
Automobiles:		
Passenger cars, no	180,547	363,471
Taxis, no	409	865
Trucks, no	41,975	51,576
Coke, byproduct, 1,000 ton	3,401	4,413
Explosives, 1,000 lb	35,688	42,019
Glass containers, 1,000 gr	2,202	2,246
Glass, plate, 1,000 sq.ft	7,979	14,011
*Glue, animal, 1,000 lb	23,131	23,278
Oil, cottonseed, crude, 1,000 lb	169,458	149,121
Oil, cottonseed, ref., 1,000 lb	102,460	84,351
*Oil, linseed, 1,000 lb	108,144	191,977
Petroleum, refined, 1,000 bbl	75,950	84,099
Pneumatic tires, 1,000	2,692	3,568
*Sulphur, ton	587,584	556,221
Rosin, wood, bbl	38,293	36,905
Turpentine, wood, gal	328,650	334,750
Pine oil, gal	229,938	222,112
Sugar, refinery meltings, ton	413,912	322,716
Consumption		
Cotton, bales	394,321	545,834
Silk, bales	55,649	53,274
Wool, 1,000 lb	38,083	49,755
Cottonseed oil, bbl	321,310	348,990

*Quarter ended Sept. 30.

The window glass trade which in 1929 fell 30 per cent below that for 1928 and which so far this year has been running about 20 per cent below 1929, now shows signs of recovery. Plate-glass manufacture also has been quickened in the last month. Textile manufacture has gone ahead in the last two months. Oil refining has held up well throughout this year. Production of superphosphate in September was 11.7 per cent larger than in September, last year. October sales of fertilizer tags for the sixteen tag-sale states were 95.7 per cent of those for October, 1929. Sales of plastic paints, cold-water paints, and calcimines as reported to the Bureau of the Census by 28 manufacturers, including the leading producers, amounted to 4,577,976 lb. valued at $261,232 for September compared with 5,867,734 lb., valued at $339,004, in August.

PRODUCTION of coal products in 1930 promises to be about 10 per cent below that of last year. The output of byproduct coke reported by the Bureau of Mines for the first nine months of this calendar year shows a decline of 11 per cent as compared with the corresponding period of 1929. However, it is well known that the slower rate of operation of ovens favors slightly increased yield of ammonia and light oil. Hence, the decline in output of these two byproducts is not likely to exceed 10 per cent. It is of special interest to note that the production of these commodities is to be as little reduced as this in view of the fact that pig-iron production has declined by 21 per cent and the production of all classes of coke, including beehive, has declined by 16 per cent. It is evident that the output of ammonium sulphate, light oil, and tar for the chemical industries is much more stable than is either pig-iron or coke.

TOTAL exports of chemicals and allied products amounted to $134,632,000 in value in the first nine months of 1930—15 per cent less than in the like period of 1929, the chemical division, Commerce Department, reports. Imports were valued at $138,940,000, or 20 per cent less than in the corresponding period of 1929.

It will be recalled that the United States imports of chemicals and allied products usually have exceeded exports by many millions of dollars each year, the chief of the chemical division points out.

The trade in the current year assumed some of its former characteristics. Methanol shipments once again approached the figures reached prior to the appearance on foreign markets in 1924 of German synthetic methanol. Formaldehyde foreign sales, so far as quantities are concerned, are only a little under the 1923 high figure.

A general reduction in price was a contributory cause to the lessened trade, since more than one-third of the various commodities comprising both exports and imports actually recorded larger quantities shipped. A few of the exported commodities, other than those mentioned, which made gains were benzol, ethers and esters, household insecticides and disinfectants, agricultural insecticides and fungicides, calcium chloride, sodium borate, caustic soda, red lead and litharge, white lead, roofing paints, and nitrocellulose lacquers.

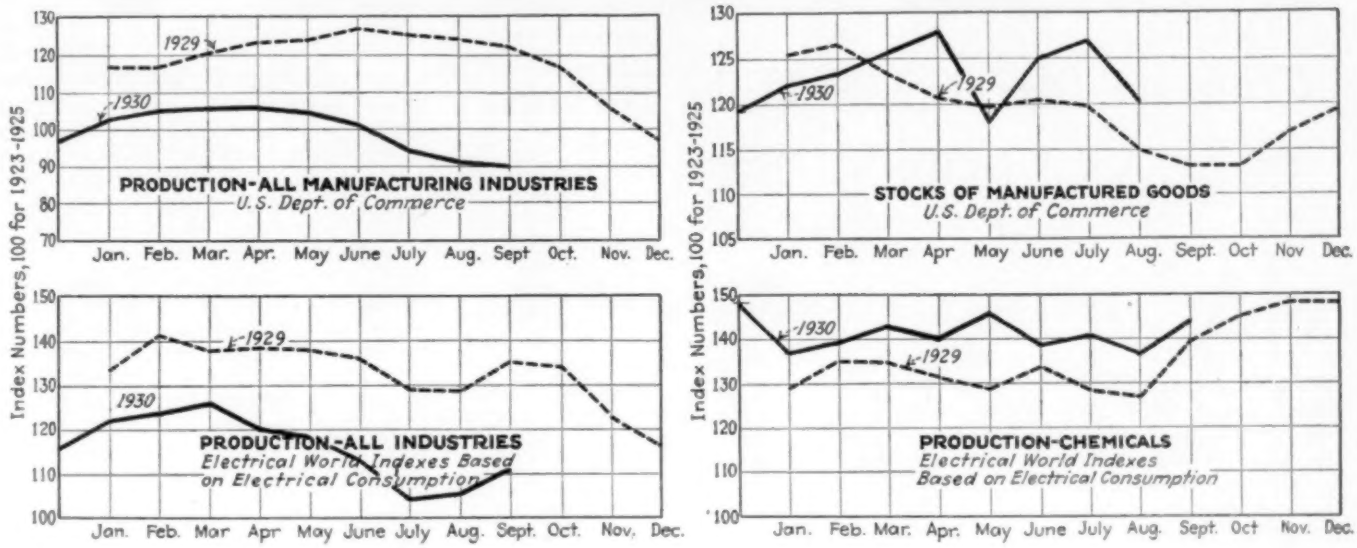
Consumer Demand Well Sustained

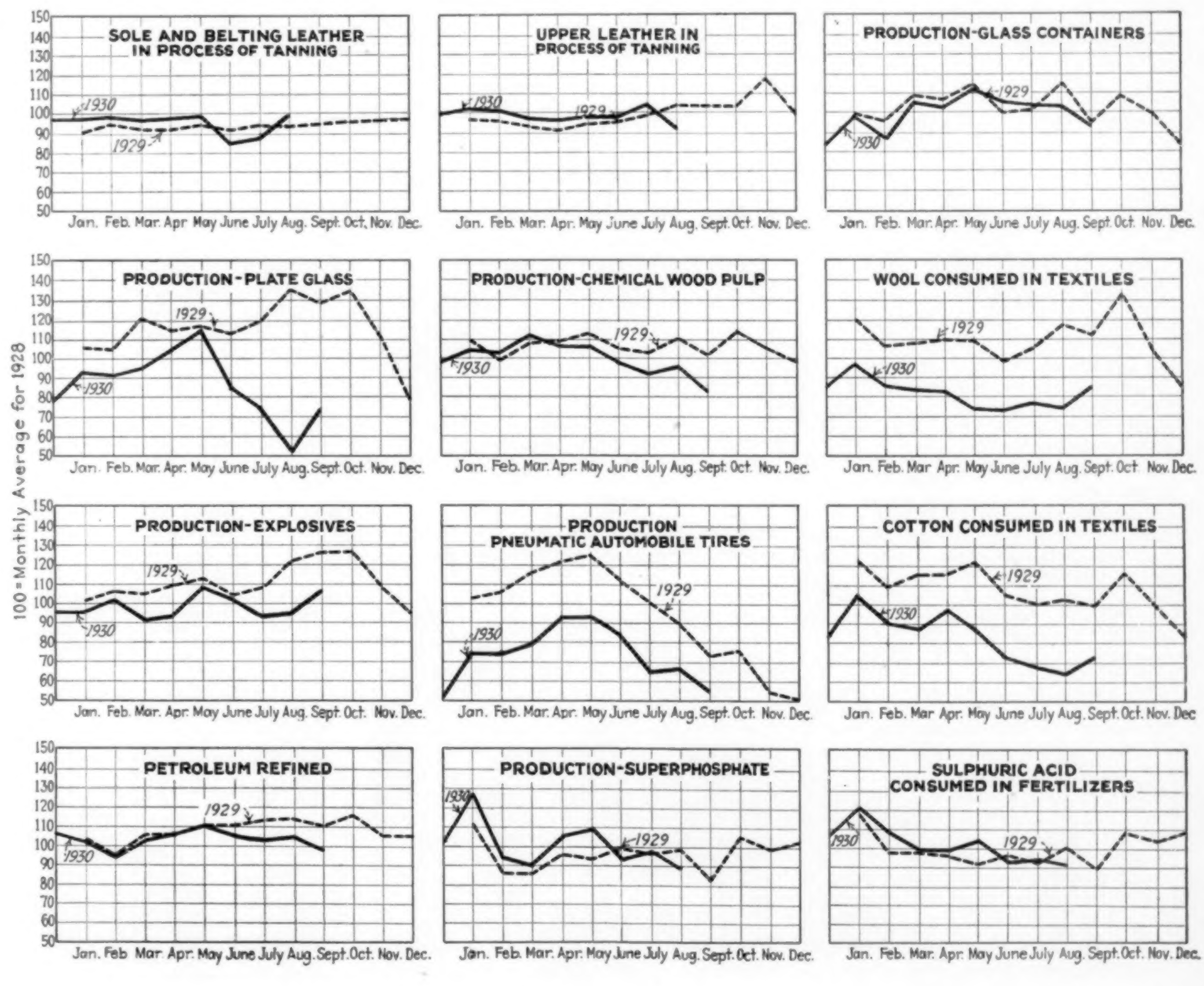
In reporting business conditions for the week ending Nov. 8, *Business Week* states that the reassuring thing about the situation is that the contraction is chiefly in industrial production and in movement of goods in wholesale channels. Consumer demand continues well sustained, and in some lines, like cotton and wool textiles, coal, residential building, has already begun to restimulate production. This situation has been evident during practically the whole of 1930, and must soon reach an acute state, as retail trade is stimulated somewhat by the holiday demand and industrial production is further curtailed during the next two months.

Commodity prices are showing further weakness, but mainly in those raw materials that have had relatively the smallest decline during the past year. The others, like cotton and cotton textiles, and metals, are showing fairly steady resistance to further deflation, and in some cases improvement.

The forthcoming conference of central bank heads in Europe holds some promise of a change in Federal Reserve policy during the next two months in the direction of stimulating recovery early next year.

ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES





MARKET CONDITIONS AND PRICE TRENDS

Contract Placements Hold Interest Of Chemical Trade

Outlook for Future Business Regarded as Promising

MAIN INTEREST in the present market for chemicals is centered in the quotations for, and the placing of, contracts covering delivery over 1931. Producers have been eager to place orders for future delivery on their books because the volume of such orders would furnish some indication of the rate at which productive activities might be established for the coming year. While a fair volume of business has been placed for future requirements, many consumers have been slow to commit themselves, influenced by the uncertain position of industry and by the lack of stability in quotations for many chemicals.

Within the last week a better tone has been noted in the market and the outlook is regarded as favoring a more active trading movement in the near future. Improvement in building operations and the probability of large expansion programs—both federal and private—being put into operation underlie the belief in a wider call for raw materials. The automobile trade has just issued optimistic reports and the prediction is made that tire production in 1931 will equal that of 1929. With greater activities forecast for such basic industries as building, steel, and automotive, there is justification for optimism among producers of chemicals.

The movement of chemicals during the last month was enlarged in some directions but as a whole did not differ much from that of the preceding month. In some cases contract withdrawals were larger, but spot trading was erratic, with no sustained buying movement.

ONE of the interesting developments of the month was found in the announcement of producers that no change would be made in the quotations for alkalis on 1931 contracts. It had been expected that new contracts would be accepted below the existing contract quotations and offerings below the quoted levels had been heard for some time. As has been the case in recent years, contract prices on large business appear to be a matter of private negotiation.

Producers of liquid chlorine have taken on considerable business for next year, but the market has suffered from competition. The output of chlorine has grown rapidly in recent years, as may be seen from the fact that domestic production for 1927 was reported at 180,163,438 lb., while that for 1929 reached a total of 241,295,383 lb., or a gain of nearly 34 per cent in the two-year period.

IT is pointed out that imports of acetic acid are showing a declining trend. While this is due in part to a contraction in consuming demand this year, it is also regarded as proof that the home output has been enlarged to take care of a larger part of domestic requirements.

During the first three quarters of 1930, imports of acetic acid totaled 18,414,000 lb., valued at $1,279,000—a radical drop from the corresponding figures of 23,455,000 lb., worth $1,726,000 for the same period of last year. This downward trend in imports is shown by the following quarterly figures of 1930: First quarter—9,425,000 lb., $732,000; second quarter—7,022,000 lb. $433,000; third quarter—1,967,000 lb., $114,000. Nearly all of these shipments are from Canada.

An important development in foreign markets was reported by our trade commissioner at Berlin, who stated that the cartel contract binding German coal-tar byproducts producers in the Sales Union for Tar Products, Ltd., of Essen, is automatically prolonged to Dec. 31, 1931, by reason of the failure of the member parties to give notice of withdrawal six months before the expiration of the cartel agreement, as provided. It is understood that negotiations may be held to invite members to commit themselves to a five-year term of contract. This is delayed, however, because of certain differences between Ruhr coal syndicate members that are simultaneously parties to the coal-tar byproduct cartel.

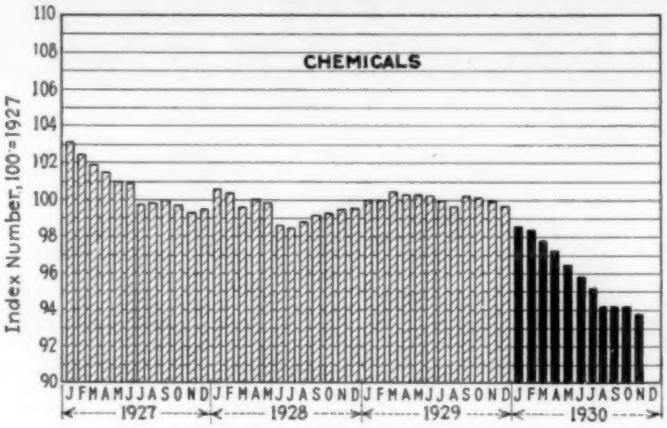
ANOTHER announcement from abroad carried significance because of its possible effect on export trade. It stated that a recent agreement by the chemical pulp industries of Germany, Norway, Sweden, Czechoslovakia, and Finland to reduce their production by 16 per cent is expected to reduce the consumption of salt cake and sulphur required for this industry. Overproduction and the development of the Canadian industry, which is now capable of supplying its own market and the United States markets, is ascribed as responsible for the agreement.

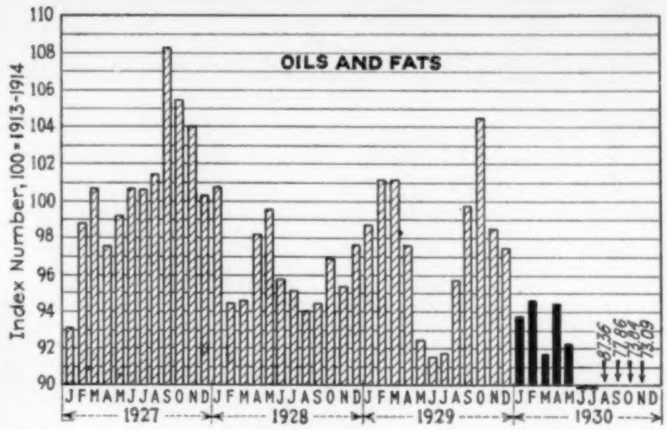
Latest available statistics reveal that the domestic branch of the wood distillation industry is operating on a relatively small scale. Production of acetate of lime for the first nine months of this year amounted to 70,494,444 lb., compared with 104,337,592 lb. for the comparable period of last year. Crude methanol production for the same period was 4,322,547 gal. and 6,166,367 gal. for 1930 and 1929, respectively.

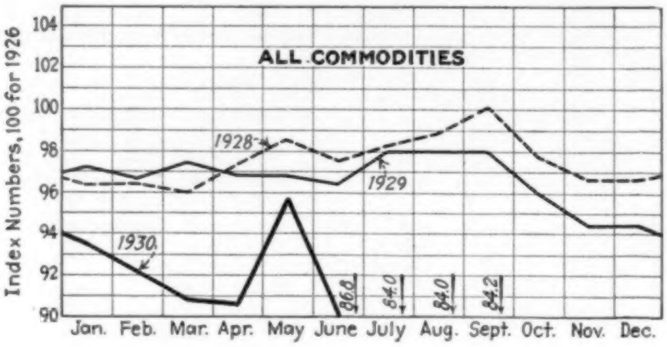
Factory Production and Consumption of Vegetable Oils

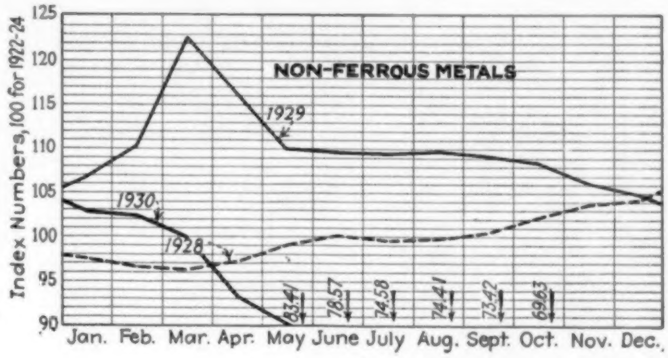
	Production		Consumption	
	Quarter Ended Sept. 30, 1930 Lb.	Quarter Ended Sept. 30, 1929 Lb.	Quarter Ended Sept. 30, 1930 Lb.	Quarter Ended Sept. 30, 1929 Lb.
Cottonseed, crude	238,750,677	203,399,311	171,982,423	147,449,781
Cottonseed, refined	158,167,124	134,913,891	323,521,464	311,613,227
Peanut, virgin and crude	2,750,535	2,309,146	2,751,189	2,521,384
Peanut, refined	2,330,798	1,788,350	2,549,508	1,555,737
Coconut, or copra, crude	85,068,486	85,012,078	150,752,555	172,456,506
Coconut, or copra, refined	69,312,892	86,791,504	76,571,959	75,678,402
Corn, crude	28,776,328	35,521,265	29,101,988	36,898,410
Corn, refined	23,252,550	29,062,346	2,559,602	4,637,390
Soya-bean, crude	1,220,439	1,455,657	4,183,240	4,537,663
Soya-bean, refined	1,817,939	1,486,608	2,169,746	1,484,038
Olive, edible	....	....	909,679	645,327
Olive, inedible	....	....	1,353,153	1,552,297
Sulphur oil, or olive foots	....	....	9,966,795	9,341,073
Palm-kernel, crude	....	....	12,120,696	17,797,004
Palm-kernel, refined	3,117,078	2,604,829	2,643,064	2,571,816
Rapeseed	....	....	3,054,279	3,555,743
Linseed	108,236,266	188,769,427	80,359,123	137,543,162
Chinese wood or tung	....	....	19,070,724	25,606,628
Chinese vegetable tallow	....	....	1,949,220	4,212,655
Castor	10,046,697	14,896,690	4,343,102	6,941,481
Palm	....	....	60,343,000	53,342,693
All other	7,774,425	3,549,908	8,551,293	3,810,490

CHEM. & MET. *Weighted Indexes of* PRICES









U. S. Department of Labor *Engineering & Mining Journal*

Competitive Influences Affect Prices for Chemicals

ACTIVITY on the part of producers to effect sales has caused instability of values, which has been apparent more in dealing on private terms rather than in actual revisions in the open quotations. It has been the usual occurrence in recent years to find shading of prices during the contracting, and the slower position of consuming industries appears to have encouraged competitive selling this year. According to reports, some consumers of heavy chemicals have been able to buy for later deliveries at very attractive prices. In some quarters it is held that selling competition may bring about drastic reductions in quotations for some selections, but others maintain that values will be steadied as buying gains in volume.

During the week, one of the steel companies announced a minimum price for its products. It was held that consumers were withholding orders because of the price situation, and to a certain extent a similar condition has existed in the chemical trade. It is generally conceded that chemicals are now selling at very low levels, and under ordinary conditions further declines except in isolated cases would not be regarded as probable.

The recent upturn in the copper market and the steadier tone in other metals adds to the opinion that raw materials are at bottom levels, and the effect should be reflected in the market for the metal salts.

In a general way the most important factor on future values will be found in the activity of buyers. The situation has shown a better aspect recently as reports of going ahead with expansion programs become more numerous. These include plant expansions, new building, and possibly the inclusion of extensive government work.

While foreign markets have been in a depressed condition, the influence of foreign-made chemicals has not been a price factor in domestic markets. Export buying likewise has been lower than it was last year, and not much change in that direction is anticipated in the near future.

The market for vegetable oils is influenced to a considerable degree by the position of world consuming markets. Recent advices from Manila state that copra and coconut oil are depressed because of conditions in foreign markets, and no recovery is expected until consuming outlets improve. The slow call for oil in European markets is illustrated by the fact that total shipments of wood oil from Hankow for the first ten months of this year amounted to 127,324,000 lb., of which 105,926,000 lb. was consigned to the United States. Large stocks held in this country have contributed to the downward price trend. Animal fats have not improved their position.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1927

This month	**93.82**
Last month	94.13
November, 1929	99.95
November, 1928	99.47

Lower prices prevailed during the month for acetic acid, ethyl acetate, sulphate of ammonia, and spirits of turpentine. An easy price tone also was noted in other cases, but no quotable changes were made.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1927

This month	**73.09**
Last month	73.84
November, 1929	98.51
November, 1928	95.30

Crude cottonseed oil closed higher than in the preceding month and corn oil also was stronger. Linseed, China wood, and menhaden oils were lower and tallow showed a lower average level for the period.

Current Prices in the New York Market

The following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Nov. 14.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums, lb	$0.11 -$0.12	$0.11 -$0.12	$0.14 -$0.15
Acid, acetic, 28%, bbl., cwt	2.73 - 2.88	2.73 - 2.88	3.88 - 4.03
Glacial 99%, tanks	8.98	......-10.76	......
drs	9.23 - 9.48	11.01 -11.26	......
U. S. P. reagent, c'bys	9.73 - 9.98	11.51 -11.76	......
Boric, bbl, lb	.06½- .07	.06½- .07	.06½- .07
Citric, kegs, lb	.46 - .47	.46 - .47	.46 - .47
Formic, bbl, lb	.10 - .11	.10 - .11	.10½- .11
Gallic, tech., bbl., lb	.50 - .55	.50 - .55	.50 - .55
Hydrofluoric 30% carb, lb	.06 - .07	.06 - .07	.06 - .07
Lactic, 44%, tech., light, bbl., lb	.11½- .12	.11½- .12	.11½- .12
22%, tech., light, bbl., lb	.05½- .06	.05½- .06	.05½- .06
Muriatic, 18°, tanks, cwt	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -......	18.50- 20.00
Oxalic, crystals, bbl., lb	.11 - .11¼	.11 - .11¼	.11 - .11¼
Phosphoric, tech., c'bys., lb	.08½- .09	.08½- .09	.08½- .09
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Tannic, tech., bbl., lb	.35 - .40	.35 - .40	.35 - .40
Tartaric, powd., bbl., lb	.33 - .34	.34 - .36	.38 - .39
Tungstic, bbl., lb	1.40 - 1.50	1.40 - 1.50	1.30 - 1.40
Alcohol, ethyl, 190 p'f., bbl., gal	2.63 -......	2.63 - 2.71	2.68½ - 2.71
Alcohol, Butyl, tanks, lb	.16½- .17	.16½- .17	.16½- .17
Alcohol, Amyl	......	......	......
From Pentane, tanks, lb	.236-......	.236-......	......
Denatured, 188 proof			
No. 1 special dr., gal	.40 -......	.40 -......	.51 -......
No. 5, 188 proof, dr., gal	.40 -......	.40 -......	.51 -......
Alum, ammonia, lump, bbl., lb	.03½- .04	.03½- .04	.03½- .04
Chrome, bbl., lb	.05 - .05½	.05½- .05½	.05½- .06
Potash, lump, bbl., lb	.03½- .04	.03 - .03½	.02½- .03½
Aluminum sulphate, com., bags, cwt	1.40 - 1.45	1.40 - 1.45	1.40 - 1.45
Iron free, bg., cwt	1.90 - 2.00	1.90 - 2.00	2.00 - 2.10
Aqua ammonia, 26°, drums, lb	.03 - .04	.03 - .04	.03 - .04
tanks, lb	.02½- .02¾	.02½- .02¾	......
Ammonia, anhydrous, cyl., lb	.15½-......	.15½-......	.15 -......
tanks, lb	.05½-......	.05½-......	......
Ammonium carbonate, powd. tech., casks, lb	.10½- .11	.10½- .11	.11 - .12
Sulphate, wks., cwt	1.70 -......	1.80 -......	2.10 -......
Amylacetate tech., tanks, lb., gal.	.222-......	2.22 -......	......
Antimony Oxide, bbl., lb	.08½- .10	.08½- .10	.09 - .10
Arsenic, white, powd., bbl., lb	.04 - .04½	.04 - .04½	.04 - .04½
Red, powd., kegs, lb	.09 - .10	.09 - .10	.09 - .10
Barium carbonate, bbl., ton	58.00 -60.00	58.00 -60.00	58.00 -60.00
Chloride, bbl., ton	63.00 -65.00	63.00 -65.00	64.00 -70.00
Nitrate, cask, lb	.07 - .07½	.07 - .07½	.08 - .08½
Blanc fixe, dry, bbl., lb	.03½- .04	.03½- .04	.04 - .04½
Bleaching powder, f.o.b., wks., drums, cwt	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, bbl., lb	.033- .033	.033- .033	.02½- .03
Bromine, cs., lb	.45 - .47	.45 - .47	.45 - .47
Calcium acetate, bags	2.00 -......	2.25 -......	4.50 -......
Arsenate, dr., lb	.07 - .08	.07 - .10	.06½- .07
Carbide drums, lb	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton	20.00 -......	20.00 -......	20.00 -......
flake, dr., wks., ton	22.75 -......	22.75 -......	22.75 -......
Phosphate, bbl., lb	.08 - .08½	.08 - .08½	.07 - .07½
Carbon bisulphide, drums, lb	.05½- .06	.05½- .06	.05 - .06
Tetrachloride drums, lb	.06½- .07	.06½- .07	.06½- .07
Chlorine, liquid, tanks, wks., lb	.024-......	.024-......	.03 -......
Cylinders	.04 - .06	.04 - .06	.05 - .08
Cobalt oxide, cans, lb	2.10 - 2.20	2.10 - 2.20	2.10 - 2.25
Copperas, bgs., f.o.b. wks., ton	13.00 -14.00	13.00 -14.00	15.00 -16.00
Copper carbonate, bbl., lb	.08½- .18	.09 - .18	.22 - .23
Cyanide, tech., bbl., lb	.41 - .46	.45 - .46	.49 - .50
Sulphate, bbl., cwt	3.95 - 4.25	4.10 - 4.25	5.50 - 6.00
Cream of tartar, bbl., lb	.24½- .26	.26 - .27	.27½- .28
Diethylene glycol, dr., lb	.14 - .16	.11 - .13	.10 - .15
Epsom salt, dom., tech., bbl., cwt	1.75 - 2.15	1.75 - 2.00	1.75 - 2.00
Imp., tech., bags, cwt	1.15 - 1.25	1.15 - 1.25	1.15 - 1.25
Ethyl acetate, drums, lb	.094-......	.096-......	.125-......
Formaldehyde, 40%, bbl., lb	.07½- .08	.07½- .08	.08½- .09
Furfural, dr., contract, lb	.10 - .12	.10 - .12	.15 - .17
Fusel oil, crude, drums, gal	1.30 - 1.40	1.30 - 1.40	1.30 - 1.40
Refined, dr., gal	1.90 - 2.00	1.90 - 2.00	2.50 - 3.00
Glaubers salt, bags, cwt	1.10 - 1.20	1.10 - 1.20	1.00 - 1.10
Glycerine, c.p., drums, extra, lb	.13 - .13½	.13 - .13½	.14 - .15
Lead:			
White, basic carbonate, dry casks, lb	.07½-......	.07½-......	.09 -......
White, basic sulphate, sck., lb	.07½-......	.07½-......	.08½-......
Red, dry, sck., lb	.08½-......	.08½-......	.09½-......
Lead acetate, white crys., bbl., lb	.11½- .12	.12 - .13	.13 - .13½
Lead arsenate, powd., bbl., lb	.13 - .14	.13 - .14	.13 - .14
Lime, chem., bulk, ton	8.50 -......	8.50 -......	8.50 -......
Litharge, pwd., csk, lb	.07½-......	.07½-......	.08½-......
Lithopone, bags, lb	.05½- .06	.05½- .06	.05½- .06½
Magnesium carb., tech., bags, lb	.06 - .06½	.06 - .06½	.06½- .07

	Current Price	Last Month	Last Year
Methanol, 95%, tanks, gal	.38 -......	.38 -......	.55 -......
97%, tanks, gal	.39 -......	.39 -......	.55 -......
Synthetic, tanks, gal	.40½- .45	.40½-......	......
anti-freeze, 76½%, tanks, gal.	.31	.31 -......	......
Nickel salt, double, bbl., lb	.13 - .13½	.13 - .13½	.13 - .13½
Single, bbl., lb	.13 - .13½	.13 - .13½	.13 - .13½
Orange mineral, csk., lb	.10¾-......	.10¾-......	.11¾-......
Phosphorus, red, cases, lb	.42 - .44	.42 - .44	.55 - .57
Yellow, cases, lb	.31 - .32	.31 - .32	.32 - .33
Potassium bichromate, casks, lb	.09 - .09½	.09 - .09½	.09 - .09½
Carbonate, 80-85%, calc., csk., lb	.05½- .06	.05½- .06	.05½- .06
Chlorate, powd., lb	.08½- .09	.08½- .09	.07½- .08½
Cyanide, cs., lb	.55 - .57	.57½- .58	.51 - .53
F'rst sorts, csk., lb	.08¾- .09	.08¾- .09	.08¾- .09
Hydroxide (c'stic potash) dr., lb	.06½- .06¾	.06½- .06¾	.06½- .06¾
Muriate, 80% bgs., ton	37.15 -......	37.15 -......	36.75 -......
Nitrate, bbl., lb	.06 - .06½	.06 - .06½	.06 - .07¾
Permanganate, drums, lb	.16 - .16½	.16 - .16½	.16 - .16¾
Prussiate, yellow, casks, lb	.18½- .19½	.18½- .19	.19 - .19½
Sal ammoniac, white, casks, lb	.046- .05	.046- .05	.047- .05
Salsoda, bbl., cwt	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk, ton	15.00 -18.00	15.00 -18.00	22.00 -25.00
Soda ash, light, 58%, bags, contract, cwt	1.32 -......	1.32 -......	1.32 -......
Dense, bags, cwt	1.35 -......	1.35 -......	1.35 -......
Soda, caustic, 76%, solid, drums, contract, cwt	2.90 - 3.00	2.90 - 3.00	2.90 - 3.00
Acetate, works, bbl., lb	.04 - .05	.04 - .05	.05 - .05½
Bicarbonate, bbl., cwt	2.00 - 2.25	2.00 - 2.25	2.00 - 2.25
Bichromate, casks, lb	.07 - .07½	.07 - .07½	.07 - .07½
Bisulphate, bulk, ton	14.00 -16.00	14.00 -16.00	12.00 -15.00
Bisulphite, bbl., lb	.03¾- .04	.03¾- .04	.03¾- .04
Chlorate, kegs, lb	.05¾- .07½	.07½- .08	.06½- .06½
Chloride, tech., ton	12.00 -14.75	12.00- 14.75	12.00 -14.00
Cyanide, cases, dom., lb	.17 - .18	.18 - .22	.18 - .22
Fluoride, bbl., lb	.08½- .09	.08½- .09	.08¾- .09
Hyposulphite, bbl., lb	2.40 - 2.50	2.40 - 2.50	2.50 - 3.00
Nitrate, bags, cwt.	2.02 -......	2.02 -......	2.10 -......
Nitrite, casks, lb	.07½- .08	.07½- .08	.07½- .08
Phosphate, dibasic, bbl., lb	.03 - .03½	.03 - .03½	.03½- .03¾
Prussiate, yel. drums, lb	.11½- .12	.11½- .12	.11½- .12
Silicate (30°, drums), cwt	.60 - .70	.60 - .70	.75 - 1.15
Sulphide, fused, 60-62%, dr., lb	.02¾- .03½	.02¾- .03	.03½- .04
Sulphite, cyrs., bbl., lb	.03 - .03½	.03 - .03¾	.02½- .03
Sulphur, crude at mine, bulk, ton	18.00 -......	18.00 -......	18.00 -......
Chloride, dr., lb	.05 - .06	.04 - .05	.04 - .05
Dioxide, cyl., lb	.06½- .07	.07 - .08	.09 - .10
Flour, bag, cwt	1.55 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin bichloride, bbl., lb	nom. -......	nom. -......	.14¾-......
Oxide, bbl., lb	.34 -......	.34 -......	.44 -......
Crystals, bbl., lb	.25½- .26	.27½-......	.33½-......
Zinc chloride, gran., bbl., lb	.06½- .06¾	.06½- .06¾	.06½- .06¾
Carbonate, bbl., lb	.10½- .11	.10½- .11	.10 - .11
Cyanide, dr., lb	.41 - .42	.40 - .41	.40 - .41
Dust, bbl., lb	.07¾- .08	.08 - .08½	.09 - .10
Zinc oxide, lead free, bag, lb	.06½-......	.06½-......	.06½-......
5% lead sulphate, bags, lb	.06½-......	.06½-......	.06½-......
Sulphate, bbl., cwt	3.00 - 3.25	2.75 - 3.00	2.75 - 3.00

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb	$0.11½-$0.12½	$0.11½-$0.12½	$0.12 -$0.12½
Chinawood oil, bbl., lb	.07 -......	.08½-......	.14¾-......
Coconut oil, Ceylon, tanks, N.Y., lb	.05¼-......	.05¼-......	.07¾-......
Corn oil crude, tanks, (f.o.b. mill), lb	.07¼-......	.07¼-......	.07½-......
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.06¾-......	.06¾-......	.07½-......
Linseed oil, raw, car lots, bbl., lb	.094-......	.10 -......	.145-......
Palm, Lagos, casks, lb	.05½-......	.05¾-......	.07 -......
Niger, casks, lb	.05¼-......	.05¼-......	.06¾-......
Palm Kernel, bbl., lb	.06½-......	.06½-......	.07¾-......
Peanut oil, crude, tanks (mill), lb	.07¼-......	.07 -......	.08¼-......
Rapeseed oil, refined, bbl., gal	.54 - .56	.55 - .58	.78 - .80
Soya bean, tank (f.o.b. Coast), lb	.08¼-......	.08½-......	.09½-......
Sulphur (olive foots), bbl., lb	.06 -......	.06¼-......	.08¼-......
Cod, Newfoundland, bbl., gal	.53 - .55	.53 - .55	.65 - .67
Menhaden, light pressed, bbl., gal.	.45 - .47	.47 - .49	.70 - .72
Crude, tanks (f.o.b. factory), gal.	.20 -......	.27½-......	.43 -......
Whale, crude, tanks, gal	.78 -......	.78 -......	......- .80
Grease, yellow, loose, lb	.04¾-......	.04¾-......	.06¾-......
Oleo stearine, lb	.08¾-......	.08¾-......	.11¼-......
Red oil, distilled, d.p. bbl., lb	.08¾-......	.09 -......	.09½- .09½
Tallow, extra, loose, lb	.04½-......	.04½-......	.07¾-......

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb	.80 - .85	.80 - .85	.85 - .90
Alpha-naphthylamine, bbl., lb	.32 - .34	.32 - .34	.35 - .36
Aniline oil, drums, extra, lb	.15 - .15½	.15 - .15½	.15 - .16
Aniline salts, bbl., lb	.24 - .25	.24 - .25	.24 - .25
Anthracene, 80%, drums, lb	.60 - .65	.60 - .65	.60 - .65

Coal-Tar Products (Continued)

	Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr., lb....	1.15 - 1.25	1.15 - 1.35	1.15 - 1.25
Benzidine base, bbl., lb..........	.65 - .67	.65 - .67	.65 - .67
Benzoic acid, U.S.P., kgs, lb.....	.57 - .60	.57 - .60	.57 - .60
Benzyl chloride, tech., dr., lb....	.25 - .26	.25 - .26	.25 - .26
Benzol, 90%, tanks, works, gal..	.21 - .23	.21 - .23	.22 - .23
Beta-naphthol, tech., drums, lb..	.22 - .24	.22 - .24	.22 - .24
Cresol, U.S.P., dr., lb...........	.14 - .17	.14 - .17	.14 - .17
Cresylic acid, 97%, dr., wks., gal.	.60 - .70	.60 - .70	.68 .70
Diethylaniline, dr., lb...........	.55 - .58	.55 - .58	.58 - .60
Dinitrophenol, bbl., lb...........	.30 - .32	.30 - .31	.31 - .35
Dinitrotoleun, bbl., lb...........	.16 - .17	.16 - .17	.17 - .18
Dip oil, 25% dr., gal............	.26 - .28	.26 - .28	.28 - .30
Diphenylamine, bbl., lb.........	.39 - .40	.39 - .40	.45 - .47
H-acid, bbl., lb.................	.68 - .70	.68 - .70	.63 - .65
Naphthalene, flake, bbl., lb.....	.04½- .05	.04½- .05	.05 - .06
Nitrobenzene, dr., lb............	.08½- .09	.08½- .09	.08½- .10
Para-nitraniline, bbl., lb........	.51 - .55	.51 - .55	.52 - .53
Para-nitrotoluine, bbl., lb.......	.29 - .30	.29 - .31	.28 - .32
Phenol, U.S.P., drums, lb........	.14½ .15	14½- .15	.15 - .17
Picric acid, bbl., lb.............	.30 - 40	30 - 40	30 - .40
Pyridine, dr., lb................	1 50 - 1.80	1 50 - 1.80	1 35 - 1.50
R-salt, bbl., lb..................	40 - .44	.44 - .45	44 - .45
Resorcinal, tech., kegs, lb.......	1 15 - 1.25	1.15 - 1.25	1.30 - 1.40
Salicylic acid, tech., bbl., lb.....	.33 - .35	.33 - .35	.30 - .32
Solvent naphtha, w.w., tanks, gal	.28 - .30	.28 -......	.35 -......
Tolidine, bbl., lb................	.91 - .93	.91 - .93	.95 - .96
Toluene, tanks, works, gal.......	35 -....	.35 -......	.35 -.....
Xylene, com., tanks, gal.........	.25 28	.25 - .28	.36 - .40

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton...	$23.00-$25.00	$23.00-$25.00	$23.00-$25.00
Casein, tech., bbl., lb...........	10½- .12	.12½- .14	.15½- .16
China clay, dom., f.o.b. mine, ton	8.00 -20.00	8.00 -20.00	10.00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb...	.04 - .22	.05 - .22	.06½- .07
Prussian blue, bbl., lb........	.35 - .36	.35 - .36	.31 - .32
Ultramine blue, bbl., lb.......	.06 - .32	.06 - .32	.08 - .35
Chrome green, bbl., lb........	.27 - 28	.27 - 28	.27 - .30
Carmine red, tins, lb..........	6.00 - 6 50	6.00 - 6 50	5.25 - 5.50
Para toner, lb................	.77 - 80	.77 - 80	.70 - .80
Vermilion, English, bbl., lb....	1 75 - 1 90	1.75 - 1.90	1.80 - 1.85
Chrome yellow, C. P., bbl., lb.	.16½- .17	.17 - .17½	.15½- .16
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	5.75 - 7.00
Graphite, Ceylon, lump, bbl., lb.	.07 - .08½	.04 - .05	.08 - .09
Gum copal Congo, bags, lb.....	.07 - .09	.07 - .08	.07½- .08
Manila, bags, lb.............	.16 - .17	.16 - .17	.15 - 18
Damar, Batavia, cases, lb.....	.16 - .16½	.16 - .19	.22 - .23
Kauri No. 1 cases, lb........	.48 - .50	.48 - 53	.48 - 53
Kieselguhr (f.o.b. N. Y.), lb.....	50.00 -55.00	50.00 -55.00	50.00 -55 00
Magnesite, calc, ton............	40.00 -......	40.00 -......	40.00 -......
Pumice stone, lump, bbl., lb.....	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb...........	03 - .40	03 - .40	.03 - .35
Rosin, H., bbl..................	5.50 -......	5 60 -......	8.75 -......
Turpentine, gal.................	.41 -	.41½-......	.52½-......
Shellac, orange, fine, bags, lb....	.43 - .44	.43 - .44	.58 - .60
Bleached, bonedry, bags, lb..	.28 - .30	.28 - .30	.52 - .54
T. N. bags, lb..............	.19 - .21	.21 - .22	.39 - .40
Soapstone (f.o.b. Vt.), bags, ton	10.00 -12.00	10 00 -12.00	10 00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton..	9.50 -......	9.50 -......	10.50 -......
300 mesh (f.o.b. Ga.), ton.....	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton..	13.75 -......	13.75 -......	13.75 -... 1

	Current Price	Last Month	Last Year
Wax, Bayberry, bbl., lb.........	$0.21 -$0.24	$0.21 -$0.24	$0.28 -$0.30
Beeswax, ref., light, lb........	.34 - .36	.34 - .36	.38 - .39
Candelilla, bags, lb...........	.15½- .16	.17 - .18	.33 - .34
Carnauba, No. 1, bags, lb....	.27 - .28	.28 - .29	.33 - .34
Paraffine, crude			
105-110 m.p., lb..............	.04 - .04½	.04 - .05	.04½- .05

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%, ton....	$200.00-.....	$200.00-.....	$200.00-.....
Ferromanganese, 78-82%, ton...	94.00-99.00	94.00-99.00	105.00-.....
Spiegeleisen, 19-21%, ton......	33.00-.....	33.00-.....	33.00-.....
Ferrosilicon, 14-17%, ton.......	39.00-.....	39.00-.....	45.00-.....
Ferrotungsten, 70-80%, lb......	1.10......	1.10-.....	1.35- ...
Ferro-uranium, 35-50%, lb......	4.50-.....	4.50-.....	4.50-.....
Ferrovanadium, 30-40%, lb.....	3.15- 3.50	3.15- 3.75	3.15- 3.75

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic, lb.........	$0.10	$0.10 -......	$0.18 -......
Aluminum, 96-99%, lb..........	.233-......	.233-......	.24 - .25
Antimony, Chin. and Jap., lb....	.07 - .07½	.07½- .08	.08¾- .09
Nickel, 99%, lb................	.35 -......	.35 -......	.35 -......
Monel metal, blocks, lb.........	.28 -......	.28 -......	.28 -......
Tin, 5-ton lots, Straits, lb.......	25 -......	.268	39½ -......
Lead, New York, spot, lb.......	5 10 -.....	.0505	.0625-......
Zinc, New York, spot, lb........	.0465-......	.0445	.0655-......
Silver, commercial, oz..........	.35½-......	.36½-......	.49½-......
Cadmium, lb...................	.70 - .75	.70 - .75	85 - .95
Bismuth, ton lots, lb...........	1.00 -	1 00 -......	1 70 -......
Cobalt, lb.....................	2.50 -	2.50 - 2.50	2 50 -......
Magnesium, ingots, 99%, lb.....	65 - 1.00	.65 - 1.00	85 - 1.10
Platinum, ref., oz..............	36 00-......	36 00-......	65 00-66.00
Palladium ref., oz..............	22.00 23.00	22 00 23 00	42.00-46.00
Mercury, flask, 75 lb...........	106 00 108.00	110.00-......	124 50-......
Tungsten powder, lb...........	1 55- 1 60	1 55- 1.60	1.10- 1.15

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks., ton.....	$7 50- $8 00	$7 50- $8.50	$5.50- $8.75
Chrome ore, c.f. post, ton.......	19 50- 24 00	21 50- 25.00	22 00- 23.00
Coke, fdry., f.o.b. ovens, ton....	2 75- 2 85	2 75- 3.85	2 85- 3.00
Fluorspar, gravel, f.o.b. Ill., ton.	18 00- 20.00	18.00- 20.00	17.00- 18.00
Manganese ore, 50% Mn., c.i.f. Atlantic Ports, unit.........	.31 - .36	31 - .36	.36 - .38
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y., lb...........	.33 - .35	48 - .50	48- .50
Monazite, 6% of ThO_2, ton.....	60.00 -......	60.00 -......	130.00-......
Pyrites, Span. fines, c.i.f., unit..	.13 -......	.13 -......	.13 -......
Rutile, 94-96% TiO_2, lb.........	.10 - .11	.10 - .11	.11 - .13
Tungsten, scheelite, 60% WO_3 and over, unit.............	12 25 - 13.50	15 25 -16.50	11.25 -11 50
Zircon, 99%, lb.................	035-..	03 -....	.03 -.....

Current Industrial Developments

New Construction and Machinery Requirements

Asphalt Plant—City of Minneapolis, Minn., c/o N. W. Elsberg, City Engr., plans the construction of an asphalt plant at 26th St. and Hiawatha Ave. Estimated cost $55,000. Work will probably be done by day labor.

Bleaching Plant and Filtration Plant—E. B. Eddy Co. Ltd., C. V. Caeser, Gen. Mgr., Hull, Que., (match manufacturers) is having plans prepared for a bleaching plant and water filtration plant. Initial cost $1,800,000. This is first unit of a large development which will cost many millions and extend over a number of years.

Brass Foundry—F. L. De Sanno, 4337 East 10th St., Oakland, Calif., had plans prepared for a 1 story, 90 x 110 ft. brass foundry and machine shop at Peralta and 18th Sts.

Bronze Foundry—General Bronze Corp., 34-19 10th Ave., Long Island City, N. Y., plans unification of facilities to single plant. Estimated cost $500,000 to $1,000,000. Maturity in January.

Chlorine Apparatus — City of Cleveland, O., will receive bids until Nov. 21, for chlorine apparatus, etc.

Carbon Electrode Plant—Spear Carbon Co., D. Miller, Gen. Mgr., St. Marys, Pa., awarded contract for the construction of a 1 story, 82 x 119 ft. carbon electrode plant, to Rogers Structural Steel Co., Corry. Estimated cost $40,000.

Alum Building—Merrimac Chemical Co., Everett, Mass., awarded contract for the construction of a 3 story, 70 x 125 ft. alum building to A. C. Peters, 56 Cornhill, Boston. Estimated cost $60,000.

Chemical Plant—Dewey & Almy Chemical Co., 235 Harvey St., Cambridge, Mass., will build a 1 story plant, on Harvey St. Estimated cost $50,000. H. L. Kennedy, 80 Boylston St., Boston, is architect. Work will be done by separate contracts.

Coking Plant — United Chemical Industries, Union Soviet Socialist Republic, Russia, awarded contract for the construction of a by-product coking plant at Magnitogorsk. First unit to include eight batteries of sixty-nine coke ovens each; 14 ft. high, 43 ft. long and 16 in. wide, to Koppers Co., Koppers Bldg., Pittsburgh, Pa. Foundation work is now under way.

Fertilizer Plant—American Fertilizer & Chemical Works, Georgetown, Tex., and c/o J. H. Thompson, 401 Andrews Bldg., Dallas, plans establishing a fertilizer plant near Jacksonville.

Fertilizer Plant—Hopkins Fertilizer Co., New Albany, Ind., awarded contract for the construction of a 150 x 180 ft. fertilizer plant to E. Embry, New Albany. Estimated cost $40,000.

Gas Plant — Fuelite Natural Gas Corp., Waltham, Mass., plans the construction of a new gas plant at Hoosick Falls, N. Y.

Gas Plant—Conventry Gas Co., c/o Johnson, Church & Co., 149 Broadway, New York, N. Y., Archts., is having preliminary plans prepared for the construction of a gas plant at Conventry, R. I. Estimated cost $40,000 to $50,000.

Gas Plant—Union Carbide & Carbon Co., 30 East 42nd St., New York, N. Y., awarded contract for the construction of a pyrofax gas plant at Hillside, N. J. to Curtis & Mink, 11 Park Pl., New York. Estimated cost to exceed $40,000.

Gas Plant—Warwick Gas Co., c/o Johnson, Church & Co., 149 Broadway, New York, Archts., is having preliminary plans prepared for the construction of a gas plant at West Warwick, R. I. Estimated cost $40,000 to $50,000.

Gas Pumping Stations—Great Lakes Pipeline Co., Independence, Kan., awarded contract for the construction of gas pumping stations at Independence, Humboldt and Paola to D. C Bass & Sons, News Bldg., Enid, Okla. Estimated cost $40,000 each.

Gas Booster Station—Phillips Petroleum Co., Bartlesville, Okla., plans the construction of gas booster stations at Alva, Panola, La Verne, Barger and Harrisonville. Estimated cost $60,000 each. A. H. Rivery, Bartlesville, is engineer.

Glass Plant—Three Rivers Glass Co., Three Rivers, Tex., plans improvements to plant to include overhauling, new equipment, rebuilding furnaces, etc. Private plans. Part of work will be done by contract and part by day labor.

Glass Bottling Plant—Dixie Glass Bottle Mfg. Co., Security Bank Bldg., Jackson, Miss., had surveys made for the construction of a glass bottle plant using natural gas from Jackson field. Toledo Engineering Co., 983 Front St., Toledo, O., are engineers.

Glass Manufacturing Plant—Santa Anna Glass Co., Santa Ana, Tex., plans to establish a glass manufacturing plant at Santa Ana. Estimated cost $100,000.

Insulation Plant—Rock Insulator Co., Wabash, Ind., is having plans prepared for the construction of a 74 x 160 ft. plant for fabricating rock wool for all types of insulation. Estimated cost $50,000. Private plans. Machinery and equipment will be required.

Chemistry and Physics Building — Radcliffe College, A. L. Comstock, Pres., 10 Garden St., Cambridge, Mass., is having preliminary sketches made for the construction of a chemistry and physics building. Estimated cost $400,000. Coolidge & Carlson, 89 State St., Boston, are architects.

Laboratories (Chemistry and Physics)—Bd. of Education, W. W. Southon, Secy., Fort William, Ont., awarded contract for the construction of a 3 story, 175 x 200 ft. technical school including chemistry and physics laboratories, etc. on Main St. to J. Tocheri, 1010 Donald St., Fort William, $411,875. Machinery and equipment will be required.

Laboratory (Spectroscopic) — Massachusetts Institute of Technology, Charles River Rd., Cambridge, Mass., is having plans prepared for the construction of a 2 story spectroscopic laboratory at Massachusetts Ave. and Memorial Dr. Estimated cost $40,000. C. T. Main Inc., 201 Devonshire St., Boston, is engineer.

Laboratory—Children's Foundation of Michigan, Frederick St., Detroit, Mich., awarded contract for a 3 story administration building and laboratory to H. G. Christman-Burke Co., Fisher Bldg., Detroit. Estimated cost $225,000.

Laboratory—Indiana State Hospital, Madison, Ind., will soon award contract for the construction of a laboratory. Estimated cost $40,000. Folts, Osler & Thompson, 1037 Architects and Builders Bldg., Indianapolis, are architects.

Laboratory — New England Medical Center, J. A. Cousens, Pres., Tufts College, Boston, Mass., is having revised plans prepared for a 5 story, 50 x 150 ft. clinic, nurse home and laboratory at Bennett and Ash Sts. Estimated cost $40,000. Andrews, Jones, Biscoe & Whittemore, 50 Congress St., Boston, are architects.

Laboratory — Scripps Institute of Oceanography, La Jolla, Calif., is having plans prepared for a 2 story laboratory. Estimated cost $150,000. L. J. Gill, Sefton Bldg., San Diego, is architect.

Laboratory—State Bd. of Education, Trenton, N. J., plans the construction of a laboratory including equipment at Montclair Normal School, Montclair, N. J. Estimated cost $36,400.

Paint and Varnish Factory—Paragon Paint & Varnish Co., 47 10th St., Long Island City, N. Y., postponed construction of factory at 10th St. and Vernon Ave. $75,000. L. A. Abramson, 46 West 46th St., New York, Archt. Project in abeyance.

Paper Plant—Fisher Bros. Paper Co., 118-20 West Columbia St., Fort Wayne, Ind., is having plans prepared for a 3 story, 30 x 150 ft. paper plant. Estimated cost $40,000. A. M. Strauss, 415 Cal-Wayne Bldg., Fort Wayne, is architect.

Paper Factory Addition—Inland Empire Paper Co., Millwood, Wash., awarded contract for the construction of a 1 and 2 story addition to paper factory to the Austin Co., 16112 Euclid Ave., Cleveland, O. Estimated cost $300,000.

Phosphate Plant — International Agricultural Corp., 61 Broadway, New York, N. Y., will soon award contract for a phosphate plant at Mulberry, Fla. Estimated cost $300,000. Private plans.

Powder Building—Constructing Quartermaster, Picatinny Arsenal, Dover, N. J., awarded contract for a group of cannon powder buildings to Rust Engineering Co., Koppers Bldg., Pittsburgh, Pa. Estimated cost $150,000.

Plant—Philadelphia Quartz Co., 6th and Grayson Sts., Berkeley, Calif., is having plans prepared for the construction of a plant at South Gate. Estimated cost $300,000. W. E. Lyons, c/o owner, is engineer.

Oil Cracking Plant—Associated Oil Co., 79 New Montgomery St., San Francisco, Calif., has work under way for the construction of an oil cracking plant, 10,000 bbl. daily capacity at Avon, near Martinez. Contract awarded for equipment and installations complete to E. B. Badger & Sons, 75 Pitts St., Boston, Mass. Estimated total cost $2,000,000.

Oil Cracking Unit—Emlenton Refining Co., Emlenton, Pa., awarded contract for an oil cracking plant to Universal Oil Products Co., 310 South Michigan Ave., Chicago, Ill. $250,000. This is last unit of $1,000,000 program.

Pipe Still — McKean County Refining Co., Farmers Valley, Pa., awarded contract for the construction of a pipe still, 2,550 bbl. toping including small pumphouse, to E. B. Badger & Sons Co., 271 Madison Ave., New York, N. Y. Estimated cost $200,000.

Refinery (Oil) — Rocky Mountain Refinery, Inc., c/o A. N. Bobbit, V. Pres., 1633 East Sixth St., Pueblo, Colo., will build first unit of oil refinery at Portland Ave. and Missouri Pacific tracks. Work will be done by day labor under the supervision of R. A. Stanton, c/o owner, Engr. Estimated cost $100,000.

Refinery (Copper) — Trefileries & Laminoirs, Havre, France, plans the construction of an electrolytic copper refinery, 30,000 tons annual capacity under a technical aid contract. Location not disclosed.

Rubber Factory—Weldon Roberts Rubber Co., 18 Oliver St., Newark, N. J., will soon award contract for the construction of a 2 story addition to rubber factory at 361-65 6th Ave. Estimated cost $40,000. M. N. Shoemaker, 10 Bleecker St., Newark, is architect.

Rubber Products Factory—International Rubber Co., c/o R. C. Sudbury, Maine, Hotel, Pueblo, Colo., awarded contract for first unit of rubber products factory, 80 x 125 ft. also will soon receive bids for warehouse. Estimated total cost $200,000. Equipment will be purchased later.

Tire and Tube Manufacturing Plant—Firestone Tire & Rubber Co., South Main St., Akron, O., plans the construction of a plant, 1,000 tires and tubes daily capacity at Buenos Aires, Argentina.

Soap Factory—Dubois Soap Co., 120 West Front St., Cincinnati, O., awarded contract for the construction of a 4 story soap factory to B. Schaefer Building Co., 215 Race St., Cincinnati. Estimated cost $50,000.

Starch Plant—A. E. Staley Mfg. Co., Decatur, Ill., awarded contract for the construction of a 3 story, 36 x 132 ft. starch grinding plant, to J. L. Simmons Construction Co., Citizens Bank Bldg., Decatur. Estimated cost $100,000.

Tile Shop—Keramic Tile & Marble Co., 80 Boylston St., Boston, Mass., awarded contract for the construction of a 1 story, 85 x 200 ft. tile shop, plant unit on Prentiss St., Roxbury, to J. Loiterstein, 73 Cornhill St., Boston. Estimated cost $40,000.

Tobacco Warehouse Building—American Tobacco Co., 111 5th Ave., New York, N. Y., plans reconstruction of a warehouse building destroyed by fire, at Durham, N. C. Estimated cost to exceed $100,000. Maturity indefinite.

INDUSTRIAL NOTES

General Water Treatment Corporation has been organized as a holding company for the interests of the Permutit Company, New York, and the Ward-Love Pump Corporation, Chicago, with W. F. Robertson as president and F. M. Bard, chairman of the board.

Chain Belt Company, Milwaukee, Wis., has appointed Alabama Machinery and Supply Co., Montgomery, and the Concrete Product Sales Co., Ltd., Oakland, Calif., as representatives.

Ozark Smelting & Mining Co. now has its sales directed by A. E. Schaffer, with headquarters at Cleveland.

Koskins Mfg. Co., Detroit, has appointed E. A. Wilcox representative at 273 Seventh St., San Francisco, Calif.

Cutler-Hammer, Inc., has appointed B. L. Donahue manager of the Buffalo district, to succeed B. A. Hansen, resigned.

Lincoln Electric Co., Cleveland, has appointed W. F. Stewart, district manager in charge of the Cleveland territory with his offices at the factory.

R. W. Cramer & Company, distributors of precision instruments, has moved to 67 Irving Place, New York.

Merco Nordstrom Valve Company has opened an office in Charleston, W. Va., at 304 Capitol St., under H. D. Ruos.

Sturtevant Mill Co., Boston, has promoted Jack Vrabek to vice-president and sales manager and also to vice-president of Strutevant Engineers, Inc.

Grasselli Chemical Company has transferred W. C. Mills from New York to the main offices at Cleveland, where he will supervise branch sales throughout the country.

Federal Cement Tile Co., Chicago, has acquired the American Cement Tile Mfg. Co., the merged company to be called the Federal-American Cement Tile Co.

Permutit Company has purchased from the Paige & Jones Chemical Co. its water softening and filter department, which has been licensed in the past.

Foxboro Company, Foxboro, Mass., has appointed A. H. Shafer manager of the Pittsburgh office.

Bailey Meter Co. has opened an office at 406 East 80th St., Seattle, Wash., under L. E. Evans and has appointed C. E. Albert manager of the Kansas City office.

Worthington Pump & Machinery Corp., Harrison, N. J., has acquired the Gilman Mfg. Co., of East Boston, Mass., but will now produce its equipment at Harrison.

United American Bosch Corporation is the new name of the combined American Bosch Magneto Corporation and the Robert Bosch Magneto Company, with representation of Robert Bosch A. G. of Stuttgart, Germany. Offices of the merged company will be Arthur T. Murray, president; Morris Metcalf, treasurer; Louis Beeh, T. J. Lange, Leon W. Rosenthal, Hermann Waker, and J. E. Wild, vice-presidents.

Carrier Corporation has been formed as a holding company to unite the 15 firms represented by the Carrier Engineering Corporation, Newark, N. J., the Brunswick-Kroeschell Company of New Brunswick, N. J., and the York Heating and Ventilating Corp. of Philadelphia.

Duriron Company, Inc., Dayton, Ohio, has appointed E. D. Spofford as advertising and publicity manager.